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SUPPLEMENTAL RESPONSE TO UNIVERSITY OF ROCHESTER INVESTIGATION COMMITTEE'S DRAFT REPORT

SUPPLEMENTAL RESPONSE SUBMITTED BY:

PROFESSOR LIYANAGAMAGE R. DIAS, PHD

SUPPLEMENTAL RESPONSE ISSUED: FEBRUARY 21, 2024

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Preface

In the landscape of academic and scientific discourse, the integrity of research and the principles of fair inquiry stand as pillars of scholarly pursuit. This Supplemental Report, serving as an extension to my initial report dated January 29, 2024, submitted in response to the Investigation Committee's Draft Report, is a testament to the enduring quest for truth and justice beyond the constraints of initial findings and timelines. It is crafted in the context of additional considerations and insights that have emerged, necessitating a deeper exploration of the complex issues that underpin the allegations and proceedings initiated by the University of Rochester's Investigation Committee.

The genesis of this supplemental report is not rooted in redundancy but in the necessity to address and expand upon critical aspects of the Draft Report for which there was insufficient time to respond. It underscores a commitment to thoroughness, reflecting a conscientious approach to navigating the multifaceted dimensions of the Draft Report, particularly in the specialized domain of low-temperature, high-pressure superconductivity. I remain committed to the pursuit of truth, especially in the face of unfounded accusations of research misconduct as set forth in the Draft Report. My commitment to the truth mandates a scientific diligence that transcends arbitrary temporal boundaries set by institutional protocols.

This report is imbued with a deep respect for the academic process and an unwavering dedication to rectifying oversights and misinterpretations that may have arisen during the investigation. By delving into additional topics identified by the Investigation Committee, this document aims to build upon the foundational issues raised in the initial submission, offering clarifications, additional evidence, and nuanced perspectives for which there was insufficient time to address regarding the Investigation Committees unfounded accusations related to the Nature 2020 (CSH) Paper, PRL 2021 (MnS_2) Paper and the NSF Early Career Award Proposal, each of which is thoroughly addressed herein.

The need for this supplemental report arises from an understanding that the complexities of scientific inquiry and the nuances of specialized research fields demand a level of scrutiny and expertise that cannot be confined within the initial investigation timeframe. It is an acknowledgment that the quest for truth and the defense of professional integrity necessitate an open-ended approach, where conclusions are drawn based on comprehensive analysis and objective evaluation rather than the expedience of procedural timelines.

Furthermore, this report seeks to underscore the importance of an investigative process that is not only thorough but also fair and unbiased. It challenges the premise that the pursuit of truth can be adequately served within the constraints of predetermined schedules, advocating instead for a process that allows for the emergence of new information and insights, however time-consuming that might be. This approach is pivotal, not only for the vindication of my professional reputation but also for the broader implications for academic freedom and the credibility of scientific research.

In presenting this Supplemental Report, it is my intention to contribute to a more informed and equitable discourse, highlighting the necessity for additional expertise, impartiality, and a

reconsideration of the investigatory framework employed by the University of Rochester. This document is a continuation of my efforts to protect my professional dignity, to uphold the sanctity of scientific inquiry, and to ensure that the principles of fairness and objectivity are paramount in the evaluation of the allegations at hand.

As we navigate through the complexities of this case, this report stands as a beacon of my commitment to truth, offering a detailed and reasoned analysis that seeks to illuminate the path towards a resolution that honors the tenets of academic integrity and the values of the scientific community. It is with hope and a steadfast belief in the principles of justice that I submit this Supplemental Report, as a pivotal contribution towards understanding the full scope of the issues and moving towards a fair and just conclusion.

I. Introduction.

a. My Journey to be a Scientist.

This section of the supplemental report incorporates by reference the entirety of the corresponding section from the Response to the Draft Report, dated January 29, 2024. This inclusion is not merely for the sake of reference but is integral to the current discourse, providing a seamless continuation and expansion of our prior investigations. To ensure coherence and facilitate a thorough understanding, the relevant content from the January 29, 2024, report is hereby fully integrated into the discussions and analyses herein.

b. Teacher and Mentor to Students.

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c. Managing Two Disgruntled Students.

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II. Background Information.

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a. Unearthly Materials, Inc.

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b. Intellectual Property Rights.

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III. National Science Foundation Policy Requirements.

a. March 16, 2023 Referral Letter.

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IV. University of Rochester Policy Requirements.

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V. The Investigation Committee.

This section of the supplemental report incorporates by reference the entirety of the corresponding section from the Response to the Draft Report, dated January 29, 2024. This inclusion is not merely for the sake of reference but is integral to the current discourse, providing a seamless continuation and expansion of our prior investigations. To ensure coherence and facilitate a thorough understanding, the relevant content from the January 29, 2024, report is hereby fully integrated into the discussions and analyses herein.

a. Composition of Investigation Committee.

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understanding, the relevant content from the January 29, 2024, report is hereby fully integrated into the discussions and analyses herein.

b. The Investigation Committee's Conflicts of Interest.

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1. Shared Employer-Employee Relationships on the Committee.

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2. Shared Publications Between Committee Members.

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3. The Target Being a Competitor of Members of the Investigation Committee.

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a. The Introduction of Unfounded Accusations Not Related to My Publications.

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understanding, the relevant content from the January 29, 2024, report is hereby fully integrated into the discussions and analyses herein.

b. The Inappropriate Demand for My Unpublished Manuscript of Proprietary Work.

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c. The Personal Relationship Between My Former Business Partner and Dr. Marius Millot.

This section of the supplemental report incorporates by reference the entirety of the corresponding section from the Response to the Draft Report, dated January 29, 2024. This inclusion is not merely for the sake of reference but is integral to the current discourse, providing a seamless continuation and expansion of our prior investigations. To ensure coherence and facilitate a thorough understanding, the relevant content from the January 29, 2024, report is hereby fully integrated into the discussions and analyses herein.

d. Dr. Marius Millot's Engagement with Professor Jorge Hirsch's Criticisms of our Work.

This section of the supplemental report incorporates by reference the entirety of the corresponding section from the Response to the Draft Report, dated January 29, 2024. This inclusion is not merely for the sake of reference but is integral to the current discourse, providing a seamless continuation and expansion of our prior investigations. To ensure coherence and facilitate a thorough understanding, the relevant content from the January 29, 2024, report is hereby fully integrated into the discussions and analyses herein.

VI. The University of Rochester's Influence in the Investigation and Its Impact on the Process

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a. The Committee's and the University's Premature and Unilateral Action: Students Removed from My Lab and Teaching, Advising and Mentoring During the Ongoing Investigation.

This section of the supplemental report incorporates by reference the entirety of the corresponding section from the Response to the Draft Report, dated January 29, 2024. This inclusion is not merely for the sake of reference but is integral to the current discourse, providing a seamless continuation and expansion of our prior investigations. To ensure coherence and facilitate a thorough understanding, the relevant content from the January 29, 2024, report is hereby fully integrated into the discussions and analyses herein.

1. Disruption of Professional Relationships.

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2. Undermining Due Process.

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3. Unfair Appearance and Stigmatization.

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4. Erosion of Trust.

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b. The University's Impropriety: University Administrator and University Attorney Collaboration in the Retraction Request of Professor Dias's Paper During the Ongoing Investigation.

This section of the supplemental report incorporates by reference the entirety of the corresponding section from the Response to the Draft Report, dated January 29, 2024. This inclusion is not merely for the sake of reference but is integral to the current discourse, providing a seamless continuation and expansion of our prior investigations. To ensure coherence and facilitate a thorough understanding, the relevant content from the January 29, 2024, report is hereby fully integrated into the discussions and analyses herein.

1. Prejudice and Bias.

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2. Adverse Impacts on the Investigation:

a. Undermining Credibility.

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b. Compromising Objectivity.

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3. Deception to Justify Interference with Co-Authors.

To justify the University's and the Investigation Committee's interference with the co-authors in spearheading a request for the LuHN paper's retraction while the investigation was ongoing, they relied on a statement from the co-authors, expressing regret for not raising concerns

contemporaneously due to perceived dependencies on me. However, a closer examination reveals the factual inaccuracy of this assertion.

Firstly, it is evident that the statement cannot hold true in light of the timeline. Co-author Nathan Dasenbrock-Gammon had ceased his affiliation with my lab in October 2022, several months before the paper's publication in March 2023. During this period, he was no longer under my supervision nor financially linked to the lab, thus having the freedom to communicate concerns to the publisher independently. Yet, no such communication occurred until the university and the Investigation Committee orchestrated the drafting of the retraction request letter, coercing co-authors to sign it.

Similarly, co-author Dylan Durkee had severed ties with my group in July 2022, almost eight months prior to the paper's publication. During this extended period, he too had ample opportunity to communicate any reservations directly to the publisher. Again, there was no such communication until prompted by the university and the Investigation Committee.

Furthermore, co-author Hiranya Pasan, who was not financially dependent on my lab but rather funded by the LLE as a Horton Fellow, also had the liberty to express concerns independently. Yet, like the other co-authors, he only voiced objections upon the university and the Investigation Committee's intervention.

All co-authors were afforded the freedom to express their ideas and concerns throughout the study. I ensured an environment where dissenting opinions were welcomed and considered. The points raised in the retraction request letter were thoroughly discussed with all co-authors, who were given the option to withdraw from the study if they had reservations. Their subsequent agreement and commitment to publication, as evidenced by pre- and post-publication email communications, demonstrate their awareness and consent.

The assertion by the Investigation Committee that co-authors "did not feel that we were able to speak freely" is unequivocally false and indicative of a predetermined agenda. This reliance on fabricated statements underscores the University's manipulation of the Investigation Committee to serve its desired outcome, rather than pursue truth and integrity in the investigation process. Such an approach is wholly inappropriate and undermines the credibility of the investigation.

c. The University Providing Contracts and Financial Remuneration to Key Witnesses.

This section of the supplemental report incorporates by reference the entirety of the corresponding section from the Response to the Draft Report, dated January 29, 2024. This inclusion is not merely for the sake of reference but is integral to the current discourse, providing a seamless continuation and expansion of our prior investigations. To ensure coherence and facilitate a thorough understanding, the relevant content from the January 29, 2024, report is hereby fully integrated into the discussions and analyses herein.

VII. Critical Omissions by the Investigation Committee.

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VIII. The Investigation Committee's Assumed Misconduct and Confrontational Approach.

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IX. The Investigation Committee's Comprehensive Access to Computational Resources and Information.

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X. Responses to the Investigation Committee's Incorrect Findings.

In responding respectfully to the Investigation Committee's unfounded allegations of misconduct, it is essential to place my replies within the larger context of potential biases arising from the Committee's composition, their limited expertise in experimental high-pressure, low-temperature superconductivity research, and the conflicts of interest previously identified. The inherent biases linked to the makeup of the Committee prompt concerns regarding the fairness and impartiality of their evaluations. Additionally, the Committee's acknowledged lack of specialized knowledge in the field under scrutiny poses significant challenges in fully grasping the intricacies of the experimental research. As I proceed to provide detailed responses, it is vital to bear in mind these factors, ensuring that the broader context in which these accusations are being examined is thoroughly understood.

C. Draft Report A. Nature 2020 (CSH) Paper

3. The χ(T) Data (magnetic susceptibility as a function of temperature) Was Not Fabricated nor Falsified.

In addressing the concerns raised by the Investigation Committee regarding the integrity of our research, specifically the accusations of data fabrication and falsification of the $\chi(T)$ data (magnetic susceptibility as a function of temperature), I feel compelled to clarify and refute these allegations with the utmost respect and scientific rigor. In this section, the committee presents a mistaken belief that the A.C. susceptibility method employed in our research indicates the presence of the Meissner effect, which is a defining characteristic of superconducting materials. I must clearly state that this belief is fundamentally flawed. The A.C. susceptibility technique, fundamentally, does not serve as proof of the Meissner effect. The most definitive demonstration of the Meissner effect involves the observation of magnetic flux expulsion, where a superconductor ejects external magnetic fields, preventing them from penetrating its interior. The lack of understanding of this basic concept raises concerns about the committee's ability to conduct a thorough investigation into this matter.

There appears to be a misunderstanding within the committee, possibly confusing A.C. susceptibility cooling data with field cooling data, of which the latter is not applicable to our study. It is critical to underline that our research exclusively involves data related to warming, and it is a well-documented fact that A.C. susceptibility measurements show consistent behavior during both the cooling and warming phases. It is crucial from the outset to state unequivocally that our use of this method was never intended to serve as direct evidence of the Meissner effect. It is my hope that this explanation will encourage the committee to correct their misinterpretation of this crucial detail.

Our research, fundamentally, does not employ the A.C. susceptibility method to demonstrate the Meissner effect, a hallmark of superconductivity characterized by the expulsion of magnetic flux from a superconductor because it is not possible. Instead, our focus has been on the accurate measurement of magnetic susceptibility during the warming phases of our experiments, a methodological choice consistent with the scientific principles guiding our field. This distinction is vital for a proper understanding of our work and the conclusions drawn from it.

Moreover, I must address the committee's expectations regarding the publication of unprocessed data within the specific context of high-pressure superconductivity research. Contrary to the committee's assertion, the practice of publishing processed data, as opposed to raw, unmanipulated datasets, aligns with the norms and necessities of clarity and precision in scientific communication, especially in our specialized field.

The oversight by the Investigation Committee of the unanimous consensus among nine leading scientists, who after thorough review found no evidence of data fabrication, falsification, or manipulation in our work, is particularly concerning. This consensus, reached by experts of undeniable repute and expertise in superconductivity research, underscores not only the integrity of our research but also the reliability of our findings and methodologies.

Furthermore, the committee's reliance on the analytical methodologies of Drs. van der Marel and Hirsch, which I argue are flawed and lack scientific soundness, necessitates a critical reevaluation. The conclusions drawn from these methodologies, based on misinterpretations and statistical manipulations, are fundamentally misguided and do not reflect the rigorous scientific process that our research adheres to.

In the subsequent sections of my response, I will delve into the specifics of these accusations, offering detailed clarifications and evidence to counter each point raised by the Investigation Committee. From elucidating the scientific basis and application of the A.C. susceptibility method in our research to addressing misconceptions about data presentation and analysis in high-pressure superconductivity, my aim is to provide a clear, comprehensive, and factual rebuttal to the allegations made.

My response, grounded in the principles of scientific integrity and transparency, seeks not only to defend the credibility of our research but also to contribute to a more informed and nuanced understanding of the complexities and challenges inherent in scientific exploration and discovery.

a. The Investigation Committee Misunderstands that the A.C. Susceptibility Method in Our Work Does Not Serve as Evidence of the Meissner Effect.

Initially, I wish to respectfully address a significant misunderstanding that has arisen concerning the scope and implications of our use of the A.C. susceptibility method in our research. The committee's report suggests that this method provides evidence of the Meissner effect, a critical phenomenon associated with superconductivity. It is imperative to clarify that this interpretation does not align with the scientific basis and application of the A.C. susceptibility technique within our study.

The A.C. susceptibility method, as employed in our research, is not designed to, nor capable of, demonstrating the Meissner effect. The Meissner effect, characterized by the expulsion of magnetic flux from a superconductor, thereby preventing the penetration of external magnetic fields into the superconducting material, is a definitive marker of superconductivity. This effect is explicitly observable through experiments tailored to exhibit magnetic flux expulsion, which is not the outcome of A.C. susceptibility measurements.

Furthermore, it seems there may have been a misinterpretation or conflation of the data types within our findings, particularly between A.C. susceptibility cooling data and what might be perceived as field cooling data. To clarify, our research does not involve field cooling experiments; instead, it focuses on observations made during the warming phases. It is crucial to understand that A.C. susceptibility measurements are consistent in behavior during both the cooling and warming phases of the experiment. This consistency is a well-documented aspect of A.C. susceptibility analysis and is pivotal to interpreting our results accurately.

I trust that this clarification will assist the committee in revising their understanding and assessment of our work. It is essential for the accurate evaluation of scientific research that the methods and results are understood in their correct context. I am hopeful that this explanation will contribute to a more informed and accurate conclusion by the committee.

b. The Investigation Committee Misunderstands That It Is Not Customary in the Field of High-Pressure Superconductivity to Publish Unprocessed Data.

In my response to the points raised by the Investigation Committee regarding our publication practices, particularly the issue of publishing unprocessed data in the field of high-pressure superconductivity, I find it necessary to clarify a significant misunderstanding. It seems there is a misconception about what is considered customary in our specialized research area compared to the broader physical sciences community.

The committee suggests that it is a common practice to publish unprocessed data across physical sciences. I must respectfully challenge this assertion and it would be helpful if the Investigation Committee could provide evidence that demonstrates this practice is prevalent in at least 20% of the work that employs the same methodologies as ours. It is crucial to understand that in high-pressure superconductivity, the background subtraction process we discuss is primarily used for visualization purposes. The background utilized for visualization purposes does not play a role in deepening our understanding of the transitions we observe.

Therefore, presenting the final, processed data is not just a matter of preference but a necessity for clarity and coherence in our scientific communication. This approach is particularly suited to the demands of high-pressure superconductivity research, where the focus is on the implications of the findings rather than the raw data itself.

I urge the committee to reconsider their stance, considering the specific practices that are prevalent in our field. Our goal is to uphold the integrity and clarity of scientific research, which, in our case, means recognizing the appropriateness of presenting processed data.

c. The Investigation Committee Disregards the Conclusions by Nine Esteemed Scientists Who Found No Evidence of Data Fabrication, Falsification or Manipulation.

In addressing the concerns raised by the Investigation Committee, it is crucial to highlight the oversight regarding the consensus among nine distinguished scientists who have thoroughly reviewed our work and found no evidence of data fabrication, falsification, or manipulation. This unanimous agreement among experts is not a minor detail but a significant endorsement of the integrity and validity of our research.

Among the experts who have validated our findings are Dr. Maddury S. Somayazulu, a leading figure in high-pressure superconductivity and a member of the team that discovered LaH10 superconductivity; Prof. Russell J. Hemley, a pioneer in the field and leading scientist in the United States for superconductivity research; Mark Bocko, Distinguished Professor and Director at the Center for Emerging and Innovative Sciences; Nicholas P. Bigelow, Lee A. DuBridge Professor of Physics and a distinguished scientist at the Laboratory for Laser Energetics; Christopher Deeney, Director and Distinguished Scientist at the Laboratory for Laser Energetics; and Andrew Cornelius, Professor and former Executive Director of HiSPEC, known for his extensive experience with the methodology used in our research. Additionally, three other superconductivity experimentalists contributed to the post-publication review process, further solidifying the credibility of our findings.

These experts, some of whom were directly involved in groundbreaking discoveries in our field and are leading figures in high-pressure superconductivity research, have meticulously examined our work. Their unanimous conclusion—that there is no evidence of wrongdoing—speaks volumes about the rigorousness and reliability of our research methods and outcomes.

Considering this overwhelming expert consensus, it is my respectful contention that the Investigation Committee's disregard for these professional opinions is not only unfounded but also undermines the integrity of the scientific review process. The validation of our work by such an esteemed group of scientists should not be overlooked or dismissed lightly. Their unanimous agreement provides a strong foundation for the credibility of our research and reaffirms the absence of any misconduct in our scientific practices. As we move forward, I urge the committee to consider the significant weight of these endorsements and to recognize the robustness and legitimacy of our research findings. This collective validation by leading experts in the field is a testament to our commitment to scientific excellence and integrity.

d. The Investigation Committee Has Merely Adopted and Copied the Flawed and Scientifically Unsound Methodologies of Drs. van der Marel and Hirsch.

I must express my reservations regarding the Investigation Committee's reliance on the analytical methodologies employed by Drs. van der Marel and Hirsch. The decision to base their conclusions on these methodologies, which I believe have not been thoroughly vetted for their scientific soundness, represents a significant oversight.

The committee's effort to replicate the analysis of Drs. van der Marel and Hirsch seemingly validates their findings, as noted in the report. However, it is imperative to understand that mere reproducibility does not equate to validation of the underlying scientific principles. The methodologies in question involve statistical manipulations and the use of scaling factors and limited data ranges that I contend are not scientifically robust. My critique centers on the assertion that reproducing an analysis without critically evaluating its methodological integrity fails to address the potential for inherent biases or flaws. In this context, we will provide details about their non-standard statistical methods and false statistical arguments.

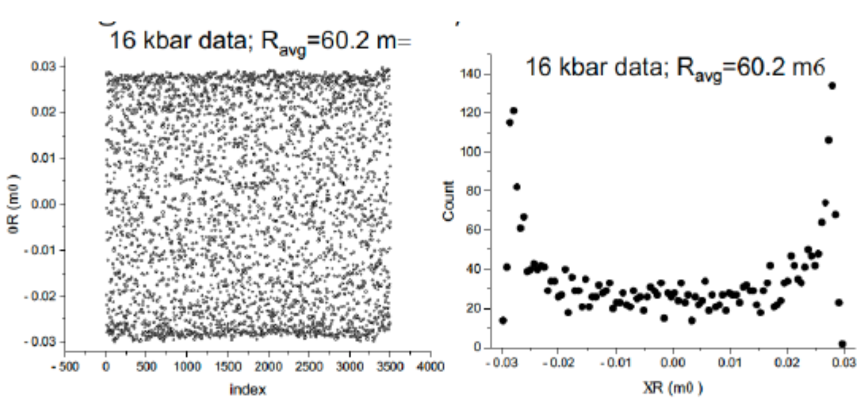

Figure 1. The resistance data at 16 kbar with unusual noise compared to typical gaussian noise.

Furthermore, I have made available a comprehensive presentation detailing these concerns, which, to my dismay, the Investigation Committee has overlooked. This lack of engagement, coupled with the refusal to allocate a dedicated time for discussion, suggests a dismissive approach to the nuances of our scientific discourse. The focus on a digitized-like structure observed in the data at 160 GPa, and the subsequent dismissal of background subtraction as a valid explanation, is a point of contention. It is worth mentioning that even distinguished scientists, who have otherwise validated the legitimacy of the data, have acknowledged the complexity surrounding the origin of these observations.

It is crucial to note that the origin of this structure was unknown, even for us. For instance, similar criticisms were directed at the resistance data for Lu-H-N, where deviations from expected Gaussian noise were noted. James Hamlin and another scientist alleged that the 16 kbar resistance data displayed “unusual” noise compared to the typical Gaussian noise. The author acknowledged the presence of significant noise, a common occurrence in resistance data. Additionally, the author pointed out that when the mean value of delta (R) was subtracted from the raw data, the resulting noise or scatter did not conform to the expected "typical" Gaussian behavior (refer to figure 1). This perspective aligns with the observations made by Hirsh and van der Marel, but it resembles more of a conspiracy theory than a scientifically grounded argument.

At the time, we had no understanding of the source or nature of this behavior, and we had to conduct new experiments to unravel its origins. The suggestion that such deviations imply methodological shortcomings overlooks the reality of experimental data, which can exhibit variability due to numerous factors. It is essential to approach such anomalies with a scientific curiosity rather than hastily attributing them to data manipulation. The foundation of my critique is not to undermine the Investigation Committee's work but to call for a deeper, more rigorous analysis that moves beyond mere replication of steps. The scientific method demands a critical examination of all aspects of research, including the methodologies employed. It is through such thorough scrutiny that we can advance our understanding and ensure the integrity of our scientific endeavors.

Upon detailed scrutiny of the data presented in the right-hand plot above, it becomes clear that the expected Gaussian behavior is not manifested. While at first glance, this anomaly may seem "unusual," it is critical to recognize that such discrepancies do not inherently indicate data fabrication. Adopting a perspective that anomalies automatically point to misconduct can bias an investigator to seek out evidence that supports this narrative. In response to these initial observations, we undertook further experiments to clarify the nature of this behavior.

Our in-depth investigations have demonstrated that the observed deviation can be attributed to the characteristics of the digital filter used, specifically a Gaussian Finite Impulse Response (FIR) filter, and its interaction with the actual spread, delta(R), of resistance measurements. The "unusual" behavior identified by critics is a result of a significant spread in delta(R) beyond the filter bandwidth implemented by the Model SR860 lock-in amplifier. Specifically, the non-Gaussian appearance documented by Hamlin et al. in Figure 1 arises because the full width at half maximum (FWHM) of the natural Gaussian noise exceeds the filter's bandwidth. This discrepancy causes data that should be distributed in a Gaussian manner to accumulate at the edges of the filter band. Conversely, when the natural Gaussian FWHM falls within the filter bandwidth, the

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anticipated Gaussian behavior is observed. This phenomenon was not apparent to us until further investigation was conducted. Thus, the quick assumption by Hamlin et al. that the non-Gaussian and "unusual" noise appearance must indicate fabrication is a leap to judgment. Similarly, it is concerning to note that the Investigation Committee has adopted a stance similar to that of Drs. van der Marel and Hirsch, using a methodologically flawed approach to hastily conclude data fabrication.

Throughout their evaluation, the Investigation Committee has consistently interpreted the presence of data that deviates from expected norms as indicative of fabrication. This methodology is fundamentally flawed and does not constitute a rigorous investigative process. Genuine evidence is necessary to substantiate claims of misconduct. It is, therefore, unfortunate that the Investigation Committee has based its conclusions on such preliminary observations, particularly by leaning on the flawed analyses of Drs. van der Marel and Hirsch.

Before proceeding with the specifics, it is necessary for me to correct several inaccurate assertions made by the Investigation Committee, which I believe are based on a misunderstanding of the data and its analysis. My intention is to correct these misconceptions with evidence-based clarifications, ensuring that our scientific discourse remains grounded in accuracy and integrity. The Investigation Committee’s misconceptions are as follows:

- Regarding the "Unusual Structure" and Background Subtraction: The committee's assertion that the observed "unusual structure" in our data is not a result of background subtraction is incorrect. This claim overlooks the nuanced and scientifically established practice of background subtraction in data analysis, particularly in high-pressure superconductivity research. Background subtraction is a critical step in highlighting relevant phenomena within the dataset, and our methodological approach in this regard is both standard and transparent. The effects observed are indeed consistent with and a direct consequence of this analytical process. Therefore, dismissing the role of background subtraction misrepresents the methodological rigor and understanding underlying our analysis.

- On the Analysis of Drs. van der Marel and Hirsch: The committee's assertion that no flaws were found in the analysis conducted by Drs. van der Marel and Hirsch necessitates reconsideration. Our examination of their methodology reveals significant oversights and misinterpretations, particularly in their statistical analysis and the application of their findings to our data. The acceptance of their conclusions without acknowledging these critical issues undermines the scientific scrutiny required for objective evaluation. It is essential that such analyses undergo thorough review to ensure that conclusions are robust, accurate, and reflective of sound scientific practice.

- Statistical Misinterpretation Concerning Independence and Correlation: The committee's agreement with Drs. van der Marel and Hirsch's claim that a zero correlation between two variables implies their independence is fundamentally flawed. This assertion represents a misunderstanding of basic statistical principles. Correlation measures linear association but does not address the broader concept of statistical independence. Variables can be uncorrelated yet still dependent through non-linear relationships. This misinterpretation

risks perpetuating incorrect statistical reasoning and conclusions within our scientific discussions and must be corrected to prevent the dissemination of misleading information.

- Misunderstanding of the PCHIP Interpolation Function: The committee's interpretation of our use of the PCHIP (Piecewise Cubic Hermite Interpolating Polynomial) function to construct the middle part of our data reflects a misunderstanding of the function's application and its significance in our analysis. The PCHIP function is employed to ensure a smooth, accurate representation of the data, particularly when interpolating between known data points. This method is widely recognized for its ability to preserve the data's qualitative features and is a legitimate analytical tool in processing scientific data. Misconstruing its use detracts from the validity of our methodology and the integrity of our findings.

I urge the Investigation Committee to reconsider these points with an open and critical perspective. It is imperative that we uphold the highest standards of scientific inquiry and discourse, ensuring that our evaluations and conclusions are based on accurate understandings of both the data and the methodologies employed. I remain committed to engaging in constructive dialogue to address these concerns, with the ultimate goal of advancing our collective understanding of the phenomena under investigation.

e. The Investigation Committee's Assertion that the "Unusual Structure is not a Result of a Background Subtraction" is Unfounded.

Contrary to the committee's first claim, the "unusual structure" observed in the data is indeed a consequence of the method of background subtraction employed. To substantiate this, we will present an entirely new dataset, not previously related to the susceptibility measurements of CSH, but rather focusing on the superconducting transition observed in the Lu-H-N system at 200 K. This approach aims to demonstrate that the discrete effects observed can be directly attributed to the choice of background subtraction, challenging the committee's initial assessment and the conclusions drawn by Drs. van der Marel and Hirsch. Through this demonstration, using data from a different system, we aim to clarify the methodological nuances that significantly impact the interpretation of the data, addressing the Investigation Committee's concerns with concrete evidence and methodological clarification.

This new dataset will serve to illustrate the effects of background choice on the data's appearance. Figure 2, below, showcases the raw susceptibility measurements obtained from the Lu-H-N sample.

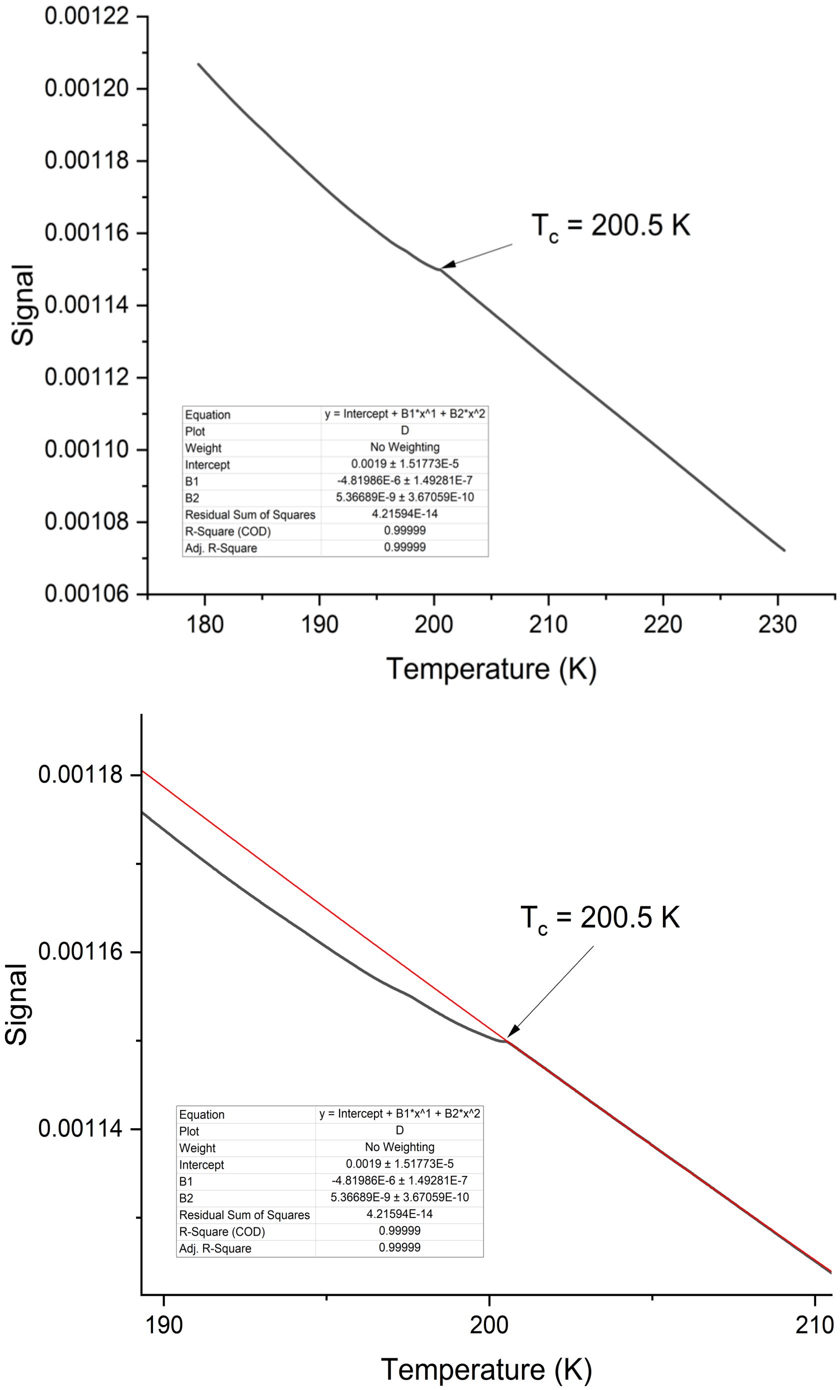


Figure 2. Top: Superconducting transition in Lu-H-N at 200 K (raw data). Bottom: For this measurement a second order polynomial background chosen above the superconducting transition.

In addressing the methodology employed in our data analysis, it's important to elucidate that the subtraction of a chosen background was implemented as a standard procedure to enhance the visual representation of the superconducting transition. This clarification is crucial, especially considering that the transition itself is discernible even in the unprocessed data. For the task at hand, we opted to subtract a second-order polynomial fit that was applied above the threshold of the superconducting transition. This step, while seemingly minor, plays a significant role in the clarity and interpretability of our results.

This approach is not uncommon in our field and serves to eliminate extraneous noise and highlight the phenomena of interest, thereby making the critical transitions more apparent. By detailing this aspect of our analysis, we aim to provide a transparent overview of the techniques used to prepare our data for presentation and further scrutiny, reaffirming the integrity of our scientific process. I invite you to examine Figure 3, presented below, which illustrates the data post-background subtraction.

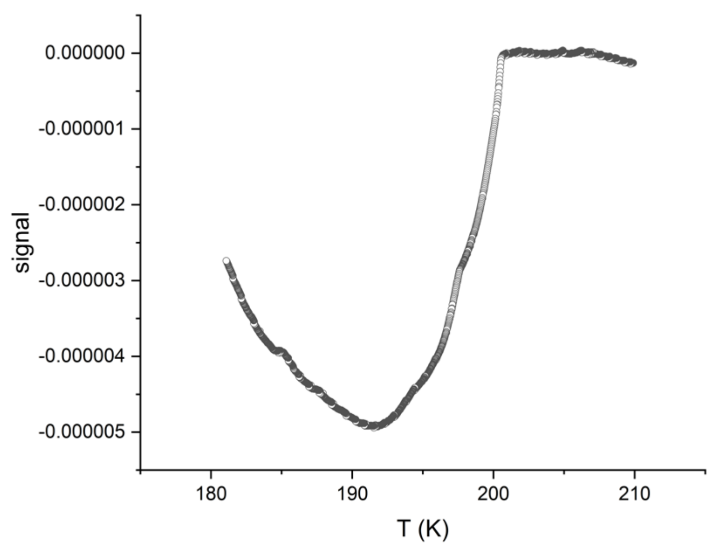


Figure 3. Superconducting transition in Lu-H-N. For this measurement a 2nd order background chosen above the superconducting transition is subtracted.

Upon careful examination of the data presented, one cannot help but notice the clear and compelling signal of superconductivity. This is a testament to the large sample size we successfully synthesized, showcasing the robustness of our experimental setup. I urge you to pay particular attention to the data regions both above the superconducting transition and below 190 K. A meticulous review of these areas will reveal the presence of discrete effects, mirroring those observed in the CSH 160 GPa data set.

To facilitate a detailed analysis, I direct your attention to Figure 4 below, which offers a zoomed-in view of the relevant sections. This close-up perspective is crucial for appreciating the subtleties of the data and underscores the consistency in the phenomena we're observing across different experimental conditions. The similarities in discrete effects across distinct data sets strengthen the argument for the inherent characteristics of the material under investigation, rather than artifacts of the analysis or experimental procedure.

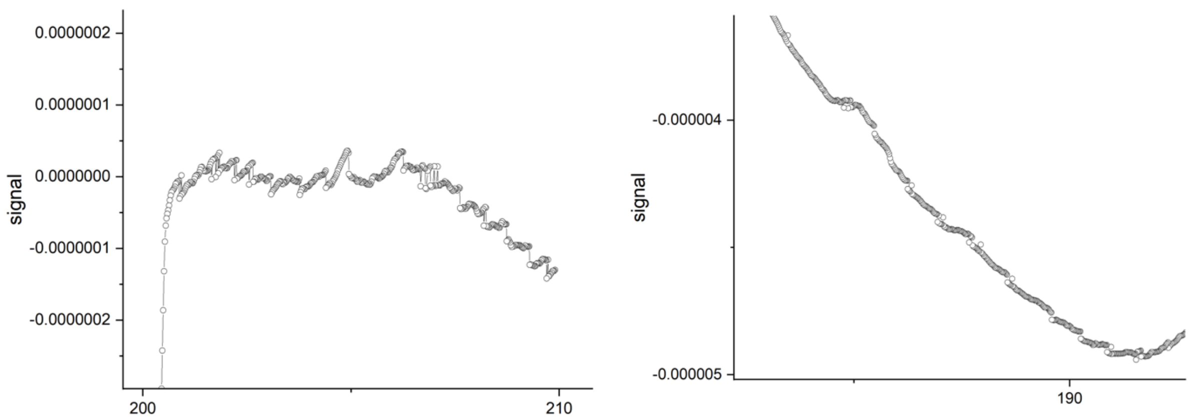


Figure 4. Zoomed in version of Figure 3 of Superconducting Lu-H-N. The similar discrete effects were observed as seen in the CSH 160 GPa data.

The example provided above illustrates unequivocally that the discrete effects observed in our data can be traced back to the influence of the background subtraction. This finding is significant, underscoring that such effects are not contingent upon employing methodologies akin to those used in UDB analyses; rather, discrete effects can emerge independently of this. The investigation into the origins of these discrete effects opens a complex avenue of inquiry, one that necessitates dedicated and focused experimental efforts to unravel.

To further substantiate this point, I will employ a third-order polynomial for background subtraction in our analysis. This approach is intended to demonstrate that the outcome, specifically the manifestation of discrete effects, remains consistent regardless of the specific background subtraction technique utilized.

This step in our methodology is critical for illustrating the reproducibility of these effects under varying analytical conditions, reinforcing the argument that the observed phenomena are inherent to the data itself rather than artifacts of a particular analytical choice. The results of this adjusted analysis are presented in Figure 5 below.

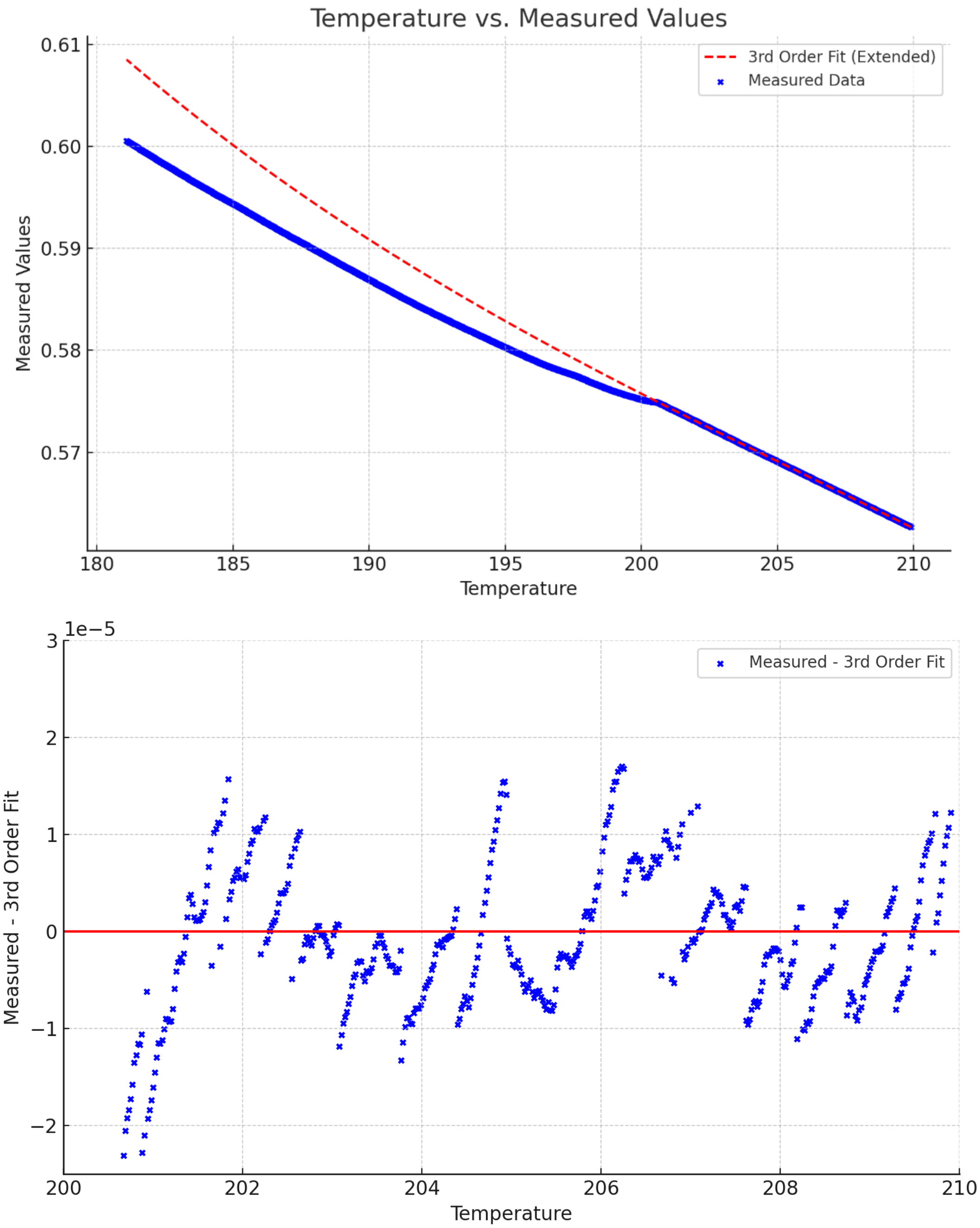


Figure 5. Top: Superconducting transition in Lu-H-N at 200 K (raw data), for this measurement a third order polynomial background chosen above the superconducting transition. Bottom: Zoomed in version of Figure background subtracted signal. The similar discrete effects were observed as seen in the CSH 160 GPa data.

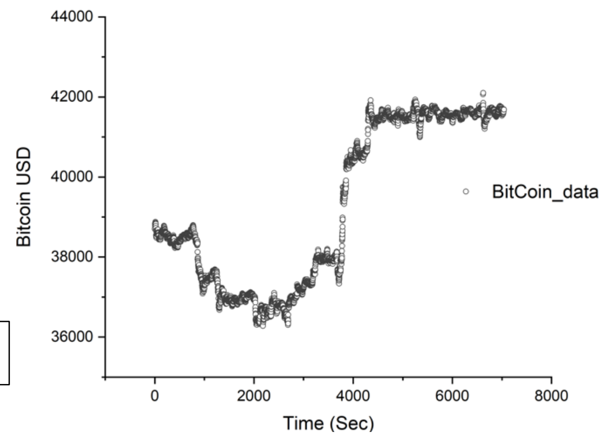
Let's turn our attention to an entirely different dataset, one that is unrelated to superconductivity, yet interestingly displays a similar trend—a noticeable drop in values over time. This example involves the share values of Bitcoin. The inclusion of this dataset serves as a comparative analysis, illustrating that the phenomenon of a significant data drop is not exclusive to the realm of superconductivity but can also be observed in completely disparate fields, such as financial markets.

This comparison is crucial for understanding that the patterns we observe in scientific data can sometimes find parallels in unexpected places. By examining the Bitcoin share values, we can gain insights into the behavior of data drops across different contexts, reinforcing the idea that the analytical methods we apply in superconductivity research are robust and can detect significant changes in datasets, irrespective of their origin.

Bitcoin data source:

Bit_coin_H Downloaded from:
https://www.cryptodatadownload.com/data/gemini/
(2022min) data
2/2/2022 9am to 2/6/2022 10pm
https://yhoo.it/3p1pxLv

Figure 6. The Bitcoin share values with time.



We will proceed to construct a background signal, referred to as UDB 1, following the guidelines outlined in our PowerPoint slides (see Figure 7). This step is instrumental in our analysis, serving as a foundation for further examination of the data. The process of defining and subtracting UDB 1 is a critical component of our analysis, allowing us to isolate and identify specific characteristics of the data that might otherwise be obscured. By employing this technique, we demonstrate the reproducibility and consistency of discrete effects across different experimental setups, further validating our analytical approach and reinforcing the credibility of our findings. Subsequently, Figure 8 will present the results after the subtraction of UDB 1 from our dataset. This demonstration reveals similar discrete effects to those observed in the CSH 160 GPa data.

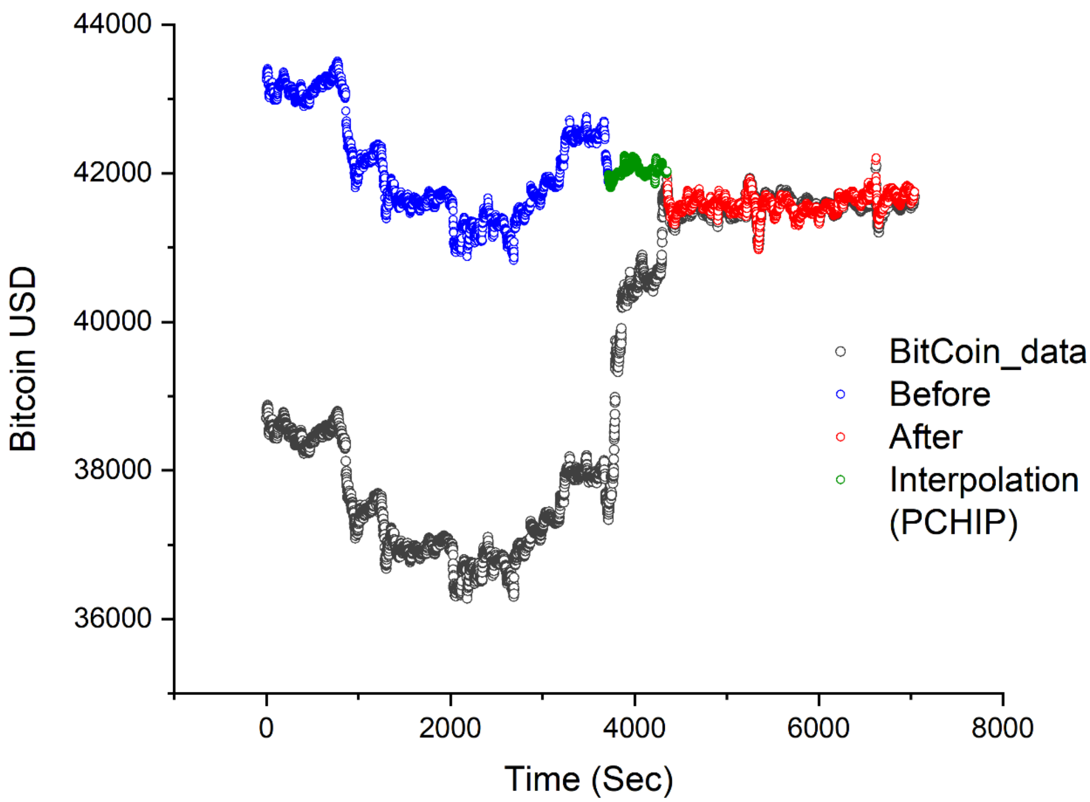


Figure 7. The Bitcoin share values and the UDB 1 constructed by using same.

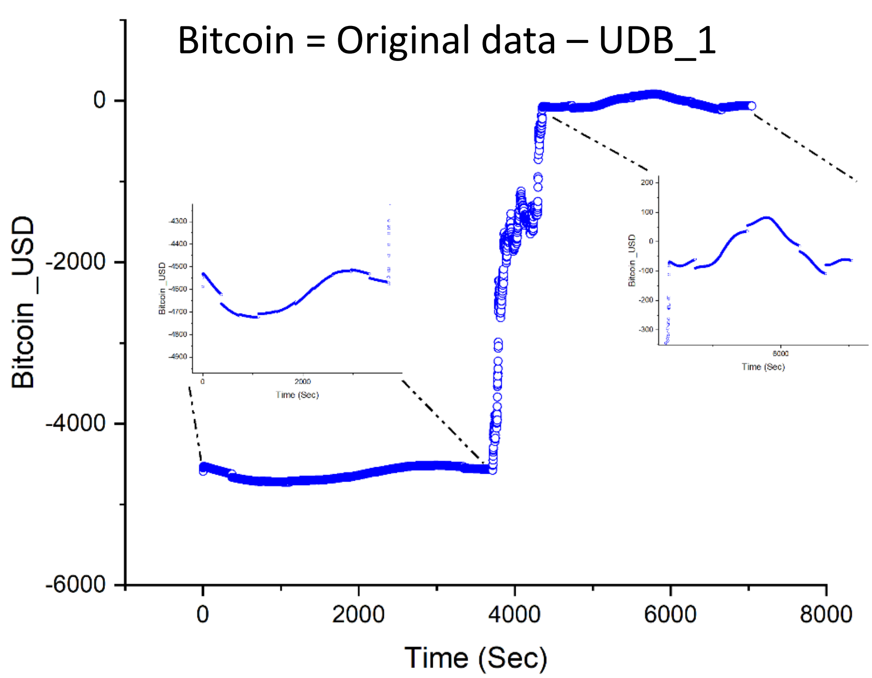


Figure 8. The background subtracted (UDB 1) Bitcoin data and two inset are the zoomed in version of background subtracted signal before and after the transition. The similar discrete effects were observed as seen in the CSH 160 GPa data.

From the example provided, it becomes evident that the occurrence of discrete effects is closely tied to the choice of background signal. This observation is crucial for understanding the impact of background selection on data analysis. It highlights the fact that the presence or absence of discrete effects can be appropriately managed through the strategic choice of background signal. By showcasing how a slight adjustment to the background can eliminate the observation of discrete effects, we underscore the importance of background selection in the interpretation of experimental data. This insight is valuable for refining our analytical techniques and ensuring the accuracy of our conclusions.

By opting for a modified version of UDB 1, which we have termed "New UDB 1," we effectively demonstrate how altering the background can influence the visibility of discrete effects, similar to those identified in the CSH 160 GPa data. An illustration of this phenomenon can be observed in Figure 9.

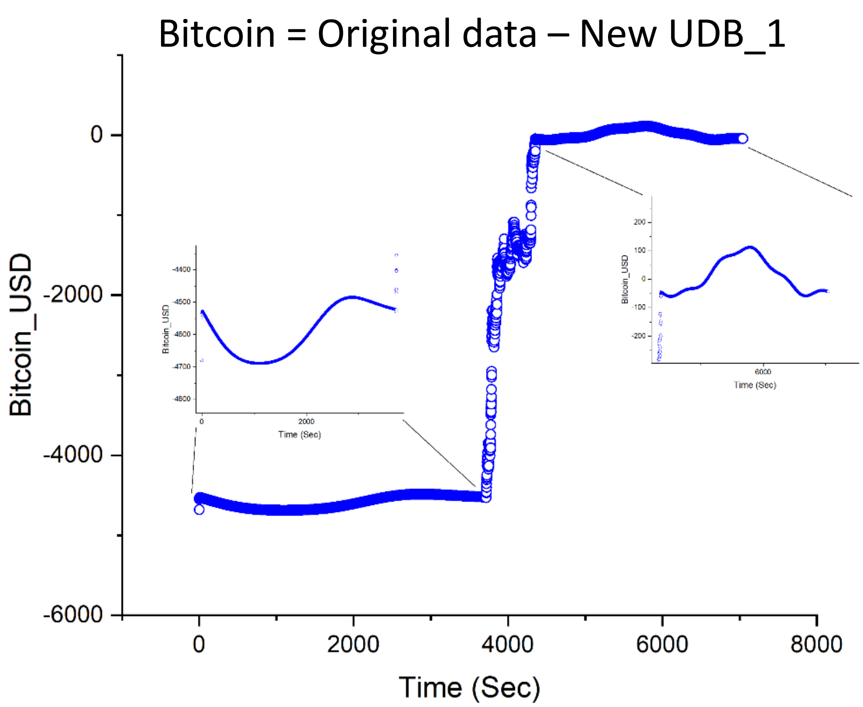


Figure 9. The background subtracted (New UDB 1) Bitcoin data and two inset are the zoomed in version of background subtracted signal before and after the transition. No discrete effects were observed.

In conclusion, the thorough analysis and examples provided throughout our discussions offer a compelling insight into the nature of the data we have examined, particularly in the context of high-pressure superconductivity and beyond. Our findings can be summarized as follows:

1. The choice of background significantly influences the appearance of discrete effects within the CSH data at 160 GPa. We have demonstrated that even minor variations in the background, as illustrated with UDB 1 and New UDB 1, can drastically alter the manifestation of these effects. This underscores the critical role that background selection plays in data analysis and interpretation.

2. The example utilizing Bitcoin data serves to further validate our approach, illustrating how the appropriate choice of background can smooth the data signal. This directly addresses concerns raised regarding the perceived smoothing of data, such as those mentioned by Hirsch, and demonstrates that such effects are a natural outcome of the analytical process rather than indicative of any manipulation.

3. Regarding the use of PCHIP (Piecewise Cubic Hermite Interpolating Polynomial) for data interpolation, it's important to recognize that exact reproduction of data values is inherently challenging due to the selection and interpolation of data points being subject to user discretion. The committee asserts that they are unable to replicate the exact curve (middle part), which is reasonable given that it was generated from randomly selected points during interpolation. It is essential to acknowledge that the results may differ for subsequent users, depending on the random points they choose. You may get close fit to it, but not exact, which was what the committee was able to achieve. This variability is inherent to the process and does not detract from the validity of the data or the methods used. To further illustrate this point, we propose a challenge to the Investigation Committee to replicate the PCHIP interpolation for the Bitcoin data, which is undeniably authentic, thereby reinforcing the legitimacy of our interpolation approach in the CSH data. This challenge, along with the detailed explanations provided in our PowerPoint slides titled "Anatomy of Background Subtraction," aims to clarify any misunderstandings and validate our analytical methods.

It is critical to emphasize that our exploration into the effects of background selection and data interpolation techniques has not only clarified the methods used but also reinforced the integrity of our scientific process. By openly addressing the concerns raised, providing clear examples, and challenging the assumptions made by the Investigation Committee, we have endeavored to demonstrate the robustness and reliability of our findings. Our approach is grounded in rigorous scientific principles, aimed at advancing our understanding of complex phenomena through transparent and reproducible research practices.

f. A Spline Was Not Added at 160 GPa.

In my response to the concerns raised regarding the alleged creation of a spline at 160 GPa, I must firmly and respectfully refute this claim. The focus of the Investigation Committee on what has been described by Drs. Hirsch and Van der Marel as a 'spline discovery' at this specific pressure point warrants scrutiny, particularly considering the methodological shortcomings and statistical inaccuracies associated with their analysis.

It is perplexing that the Investigation Committee has anchored its suspicions on the presence of a spline at a singular pressure point. Logic dictates that if the intent were to manipulate data, consistency across all pressure points would be expected, not an isolated occurrence. Yet, it is evident that none of the other pressure points exhibit similar characteristics under the same analytical lens, even when applying the criticized methodology. This observation raises significant doubts about the rationale used to infer misconduct or data manipulation.

Moreover, the basis of the Investigation Committee's conclusion, predicated on the "most probable explanation" and deeming results as "highly improbable," raises concerns about the standards being applied to accuse a scientist of research misconduct, data fabrication, or falsification. Such standards should not rest on the subjective assessment of probability but should be grounded in concrete evidence and rigorous scientific analysis.

Therefore, I challenge the Investigation Committee to reconsider its stance, considering the inconsistencies in the application of their methodology and the lack of uniform evidence across all pressure points. The leap to accusations of misconduct based on a speculative and isolated interpretation does not align with the principles of objective scientific inquiry. I urge a more balanced and evidence-based approach in evaluating the data and the methodologies employed, free from bias and premised on the integrity of the scientific process.

To fabricate or falsify data involving the creation of an alleged spline, particularly in a complex scientific context, a series of intricate and deliberate steps would be required. Here is a breakdown of what such a process might entail:

1. Initial Data Point Generation: The process would begin with the generation of 15 temperature points, strategically chosen to be unevenly and randomly spaced. This initial step sets the groundwork for creating a pattern that appears natural and irregular, mimicking genuine experimental data.

2. Application of Cubic Spline Fitting: For each of these points, a fit using cubic spline interpolation would be employed to create a smooth curve. To enhance the believability of this fit, a mathematical technique involving the Taylor series could be applied to each point, and the results averaged. This step ensures the smooth curve convincingly connects the dots, simulating a plausible scientific phenomenon.

3. Incorporation of 'Noise': Deliberately introducing 'noise' into the data set adds a layer of complexity and realism. This noise, characterized by discrete fluctuations of a specified magnitude, would be unevenly distributed across the data points, further mimicking the randomness of actual experimental outcomes.

4. Construction of Underlying Trends: To convey a specific scientific phenomenon, such as a phase transition, a second curve representing the overall slope or trend of the data would be crafted. This curve is designed to subtly guide the interpretation of the data towards the desired conclusion.

5. Combining Curves to Simulate Data: The smooth curve, now interspersed with artificial noise, and the curve representing the overall trend, would be meticulously combined. This synthesis produces a final 'made-up' signal that appears to reflect a genuine scientific measurement.

6. Replication Across Different Conditions: To lend further credibility to the falsified dataset, this entire process would be replicated for other pressure points. Each iteration would

involve adjusting the parameters and characteristics of the noise and trends to maintain consistency with the overarching narrative being presented.

The likelihood of undertaking such an elaborate and methodically intricate process—comprising the generation of unevenly spaced temperature points, fitting these with a cubic spline, deliberately adding and spacing 'noise,' constructing an underlying trend through a second curve, and then combining these elements to fabricate a signal—for the singular purpose of manipulating only one data point, specifically at 160 GPa, while not applying the same meticulous falsification across any other data points, is exceedingly implausible. This scenario requires a level of precision and intentionality that, if genuinely motivated by a desire to mislead, would logically be applied more broadly to ensure consistency across the dataset. The singular focus on a lone data point, without similar manipulations observed at other pressures, starkly contrasts with the rationale behind data fabrication, which typically aims to construct a cohesive narrative or trend within the scientific research. Such an isolated instance of alleged fabrication not only defies the common motives underlying scientific misconduct but also suggests a misunderstanding or misinterpretation of the data and methodologies employed.

g. Our Data is Valid and Advances Our Understanding of Hydride Superconductivity

I would like to take this opportunity to elucidate the significance of our data and its contribution to advancing our understanding of hydride superconductivity, as well as to affirm the integrity and validity of our research findings.

The methodology employed in our experiments for measuring ac susceptibility is deeply rooted in a well-established experimental framework, pioneered by the group led by Jim Schilling at Washington University in St. Louis. This framework was initially developed by Stefan Klotz and is detailed in the publication: Klotz S, Schilling JS, Muller P. "Application of a diamond anvil cell for the study of the magnetic-susceptibility of ceramic superconductors under hydrostatic-pressure," within Frontiers of High-Pressure Research in 1991. The technique involves detecting small superconducting (or ferromagnetic) transitions as changes in induced voltage—measured as the root mean square (rms) value—in a lock-in amplifier, pursuant to Faraday's Law, at the phase transition point.

It is important to note that the signal we observe due to the transition is naturally embedded within a larger signal that encompasses significant contributions from the ac field, the gasket, and the pressure cell itself. This necessitates a sophisticated understanding of the setup where the magnetic field is generated by a primary coil, which is wrapped around a secondary coil system containing the sample. Klotz's application of this system to High Tc oxides, including results on YBCO that showcase a ~8 nV superconducting transition, is a testament to the technique's reliability and effectiveness. This technique's adoption and adaptation by numerous laboratories worldwide underscore its significance in the field. Our research builds upon this foundation, aiming to extend the scientific community's understanding of superconductivity under high-pressure conditions. The methodology and results we have presented are not only consistent with established scientific practices but also represent a critical contribution to ongoing research efforts in this area.

Therefore, in addressing the Investigation Committee's accusations, it is imperative to recognize the robust experimental foundation upon which our work stands, as well as the rigorous analytical processes we have employed to ensure the accuracy and reliability of our data. The raw data presented in Fig. 10, with a linear fit to the background above the critical temperature (Tc), thereby averaging a 0 nV signal in this range, exemplifies the method's precision and its utility in superconductivity research.

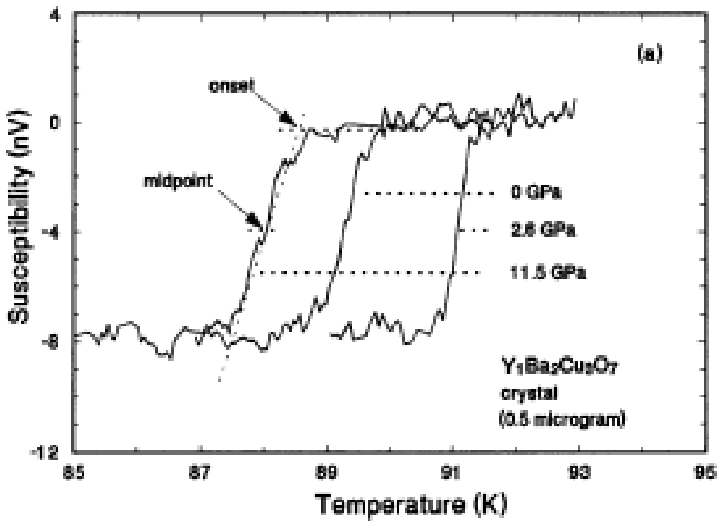


Figure 10. Superconducting transition in YBCO from Ref. 1. For this measurement a linear background chosen above the superconducting transition is subtracted.

Clarifying the nature of noise within the context of our experiments is crucial for understanding both the challenges and the methodologies applied in our measurements. Noise, in this scenario, is categorized into two distinct types: 'extrinsic' noise, which originates from the experimental environment (denoted as V_{ext}), and 'intrinsic' noise, primarily attributed to Johnson noise within the pickup coil system (represented as V_J).

In the data exemplified by Fig. 10, we observe two different patterns of noise. The 'slower' undulations in the background are the result of V_{ext}, while the 'faster' features can be attributed to V_J. The predominant sources of extrinsic noise in our measurements were largely due to the significant unbalanced signal from the gasket material and vibrations. Despite efforts to null the applied field by winding the concentric coils, eddy currents generated by the gasket were not fully compensated for, leading to a pronounced background signal.

To mitigate these effects, our approach included the use of dummy secondary coils, which, while effective, introduced additional V_{ext} noise. Through meticulous optimization of electrical connections, careful elimination of ground loops, and adopting a strategy of conducting measurements during warming in drift mode post-midnight, we were able to minimize the impact of V_{ext} noise significantly.

Moreover, concerted efforts were made to reduce the influence of V_J. Johnson noise, an intrinsic property of metals, arises from the random motion of conduction electrons even in the absence of an external magnetic field. The magnitude of V_J for a given resistance R (in Ω), T (in K), τ (lock in time constant in s) and NF (preamplifier noise factor in dB) is given by:

$$V_J = 0.0084\ \mathrm{nV}\sqrt{\frac{RT}{\tau}} \times 10^{\left(\frac{NF-1}{20}\right)} \qquad (1)$$

By addressing both extrinsic and intrinsic noise sources with a combination of innovative engineering solutions and rigorous experimental protocols, we have endeavored to ensure the reliability and accuracy of our data. This detailed explanation underscores the complexity of high-precision measurements and the lengths to which we go to uphold the integrity of our scientific investigations.

The methodology to effectively manage both extrinsic and intrinsic noise sources, as detailed in our experimental setup, was notably pioneered by Professor Andre Andrew Cornelius. Professor Cornelius, who honed his expertise under the mentorship of Professor Schilling, has played a pivotal role in the development and widespread adoption of these noise mitigation techniques within the group. His contributions have significantly enhanced the precision and reliability of measurements, establishing a robust framework that underpins our experimental approaches. This legacy of meticulous attention to detail and the pursuit of experimental excellence is a cornerstone of our work, reflecting the high standards set by predecessors in our scientific community.

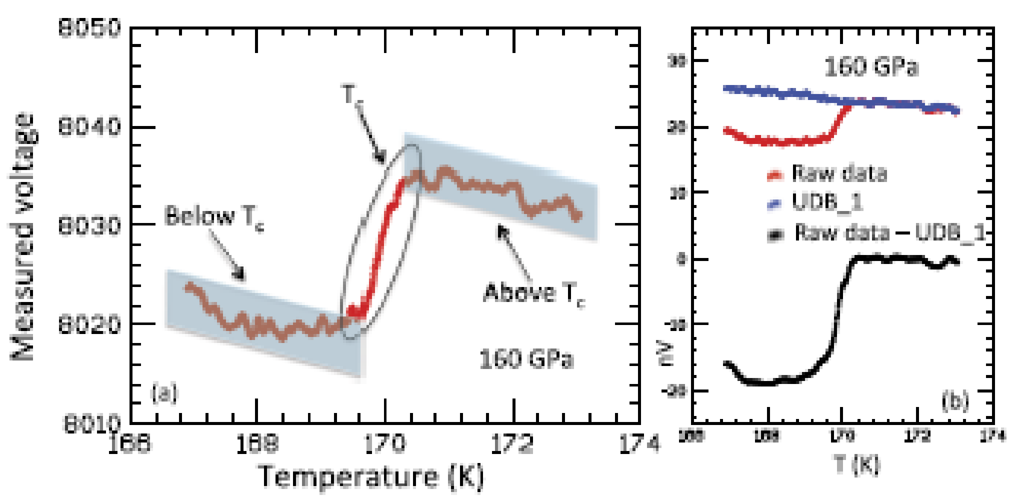


Figure 11 – Prof. Hirsch's interpretation of the 160 GPa experimental C-S-H data.

Our research on C-S-H utilized a coil system inspired by the esteemed group led by Professor Schilling, tailored to measure superconductivity at temperatures above 200 K. It is important to note that the experimental setup and the resulting data characteristics for C-S-H are expected to exhibit differences compared to those depicted in Fig. 10, particularly due to the temperature-dependent background from eddy currents. This background noise is significantly influenced by the rate of change of resistance with temperature (dR/dT), which is nearly negligible around 10 K

but becomes substantially larger at higher temperatures. This effect is observable in the C-S-H data, where the background increases with rising temperature.

The principal allegation from our critics' centers on the data for C-S-H at 160 GPa, which they claim has been artificially constructed. Their arguments are presented in Fig. 11, with the data being publicly accessible for review. (https://jorge.physics.ucsd.edu/nonmeasuredvoltage.html). In their analysis, the left plot displays the raw data, while the right plot is intended to illustrate their interpretation of our background subtraction process. The critic, Prof. Hirsch, specifically accuses the data presented on the right of being artificially smoothed and contends that the methodology behind the background subtraction has been misrepresented.

It is crucial to address these accusations with a clear explanation of our methodology. The process of background subtraction, particularly in high-temperature superconductivity research, is a nuanced and complex procedure, essential for isolating the signal of interest from the pervasive noise inherent in experimental measurements. The approach we employed is consistent with established scientific practices, designed to enhance the clarity and interpretability of the superconducting transition signal amidst the larger temperature-dependent background noise.

Our commitment to transparency and scientific integrity means that all steps of our data processing, including background subtraction, are conducted with the utmost care and adherence to rigorous analytical standards. Assertions of artificial smoothing and dishonest representation misinterpret the technical challenges and the sophisticated analytical techniques necessary to accurately characterize superconductivity in C-S-H at unprecedented temperatures.

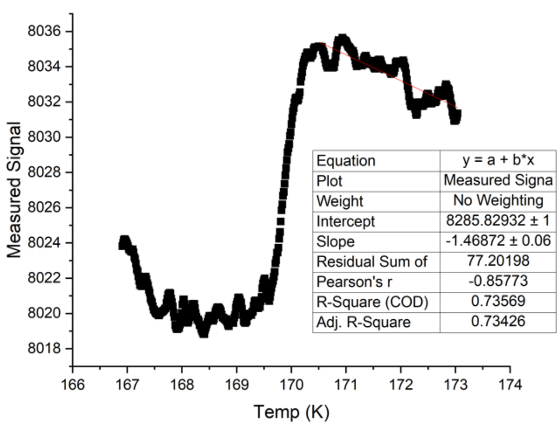


Figure 12 – Raw data with linear fit shown.

We begin by examining the raw data, specifically fitting it to a straight line above the critical temperature (Tc), as illustrated in Fig. 12. Subsequently, in Fig. 13, we present a comprehensive analysis comprising three components: (P1) the result of subtracting the linear fit from the raw data, (P2) the superconducting signal isolated from this process, and (P3) the application of a 20-point adjacent averaging to the initial plot (P1).

Upon comparison, it is evident that the 'waviness' in the data, which we attribute to extrinsic noise (V_{ext}), exhibits a pronounced similarity between P2 and P3, and is noticeably less pronounced in

P1. This observation suggests that both P2 and P3 have undergone a process of smoothing, whether electronically or manually, in contrast to P1. This detailed examination reveals the presence of a discrete effect within our original dataset, which can be directly traced back to the method of background subtraction employed. The analysis underscores the critical impact that the choice of background has on the interpretation of the data, particularly in highlighting or obscuring specific features within the dataset. To delve deeper into the characteristics of the 'noise' within this dataset, we analyze the difference between successive temperature data points as a function of temperature, as depicted in Fig. 13.

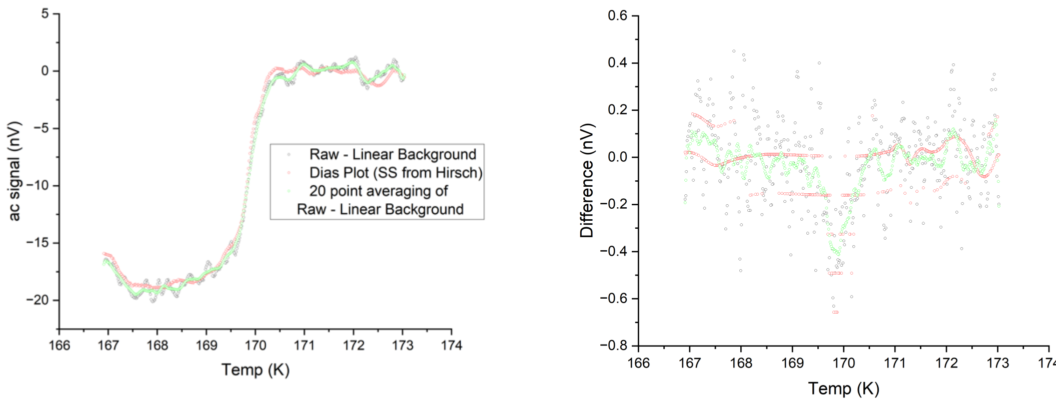


Figure 13 – (Left) Superconducting signal of C-S-H plotted three different ways. (Right) Difference of successive points from left hand plot.

To elucidate the process of isolating Johnson noise (V_J) within our dataset, we embarked on a specific analysis by subtracting P3 (which represents the smoothed signal with reduced extrinsic noise, V_{ext} from P1 (the original data with linear background subtraction). This subtraction aimed to eliminate the V_{ext} noise, focusing on the intrinsic fluctuations by examining the difference between successive data points. The findings, depicted in Fig. 16, reveal an average noise level of 0.0054 nV across 151 data points, aligning closely with the expected near-zero value. This outcome suggests that the root mean square (Vrms) value of 0.27 nV is indicative of Johnson noise, which is anticipated to be of a similar magnitude under the given experimental conditions.

To accurately estimate V_J, it was necessary to consider the temperature dependence of the coil resistance. Utilizing fine wires sourced from California Wire company, with the primary coils exhibiting a room temperature resistance of approximately 46 $\Omega\,(+-2\,\Omega)$, we observed a significant reduction in resistance at 170 K, approximately halving to or 23 Ω. These measurements were conducted with a lock-in time constant of τ=3 seconds and an operating frequency that resulted in a noise factor (NF) of 1 dB for the SR554 preamplifier. Based on these

parameters, our calculated estimate for V_J, using Equation 1 is 0.30 nV, which shows excellent agreement with the experimental results.

This analysis substantiates the authenticity of our C-S-H susceptibility measurements. By applying a minimal background subtraction technique to the raw data and revealing a clear superconducting transition, we demonstrate the validity of our approach. The observed discreteness in the C-S-H transition, attributed to our choice of background subtraction, and the significant reduction in external noise through smoothing and adjacent averaging, underscore the reliability of our findings. Furthermore, the close alignment of the estimated Johnson noise with experimental values reinforces the genuineness of our data. It negates the possibility of manual data manipulation, affirming the integrity of our experimental results and contributing valuable insights into the study of superconductivity.

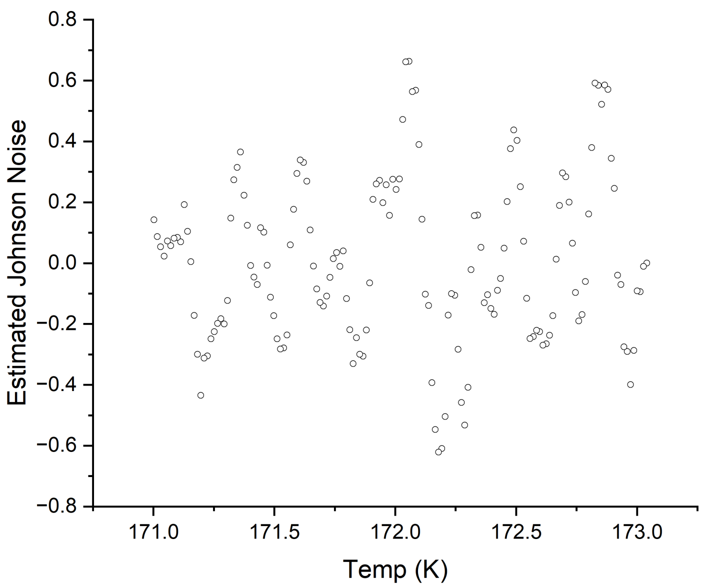


Figure 14 – Estimated Johnson noise for data above T_c calculated by taken the difference of (P1) and (P3) in Figure 5.

h. Instrument Sensitivity and Digitization

Addressing the Investigation Committee's concerns regarding the sensitivity and digitization capabilities of our instruments, specifically the SRS 860 lock-in amplifier, is crucial for understanding the precision and accuracy of our measurements. The SRS 860, a digital lock-in amplifier, employs an 18-bit Analog-to-Digital Converter (ADC) to sample the input signal, offering a resolution of 0.00000381469 x full-scale value of the input and contingent upon the internal preamplifier settings. The full-scale value depends on the internal preamp settings. It can be set to either 10 mv, 30 mV, 100 mV, 300 mV, or 1V. For instance, utilizing the 100 mV range results in a resolution of 0.38 μV at the analog front end. According to SRS technical support, the effective resolution surpasses this, achieving an effective bit rate of 24 bits through oversampling techniques.

Following ADC sampling, the signal undergoes digital processing by the instrument's microprocessor, including the DSP (Digital Signal Processor), which calculates the real,

imaginary, amplitude, and phase components of the signal entirely within the digital domain. It is important to note that data retrieval involves direct querying from the lock-in amplifier's processor via a USB connection, bypassing any digital-to-analog conversion processes and ensuring the integrity and fidelity of the digital signal.

Our data recording protocol involves querying the processed digitized signal from the lock-in amplifier at regular intervals, typically one sample per second, directly pulling this information without any intermediary analog-to-digital or digital-to-analog conversions. The representation of the data in our files, governed by the LabView code used (e.g., SGL, EXT, DBL), does not reflect the actual measurement resolution or precision, which is significantly higher as demonstrated by the effective 24-bit rate analysis. Therefore, the resolution can be calculated as:

$1/2^{24} = 5.96\text{x}10^{-8}$ x full-scale value of the input

Let's assume we used 300 mV range with 100x pre-amp.

So, the resolution would be

$$= 5.96\text{x}10^{-8}\ \text{X}\ 300\ \text{mV}$$
$$= 1.788\ \text{x}10^{-8}\ \text{V}$$

Since we used 100 x pre amp

$$= 1.788\ \text{x}10^{-8}\ /\ 100\ \ \text{V}$$
$$= 1.788\ \text{x}10^{-10.}\ \text{V}$$

So the limit of your instrument is ~ 0.18 nV. In other words, with the effective bit rate of 24 bits and using a 300 mV range with a 100x pre-amplifier, the instrument's resolution reaches approximately 0.18 nV, showcasing the exceptional sensitivity of our measurement apparatus.

Considering these technical details, the terms 'most probable explanation' and 'highly improbable' used by the Investigation Committee to frame their conclusions lack the definitive evidence necessary to substantiate accusations of research misconduct. Scientific integrity demands that allegations of such gravity be supported by unambiguous and concrete evidence. In the absence of such evidence, these claims stand on speculative grounds, underscoring the need for a thorough and objective reevaluation of the Investigation Committee's methodologies.

i. The Flawed Analysis of Profs. Van der Marel and Hirsch as Adopted by the Investigation Committee

In addressing the Investigation Committee's assertion that no flaws were found in the analysis conducted by Drs. van der Marel and Hirsch, I present a critical examination that reveals significant shortcomings in their methodology. This critique is grounded in a detailed analysis of their process of 'unwrapping' the data, as illustrated in Figure 15 as shown below.

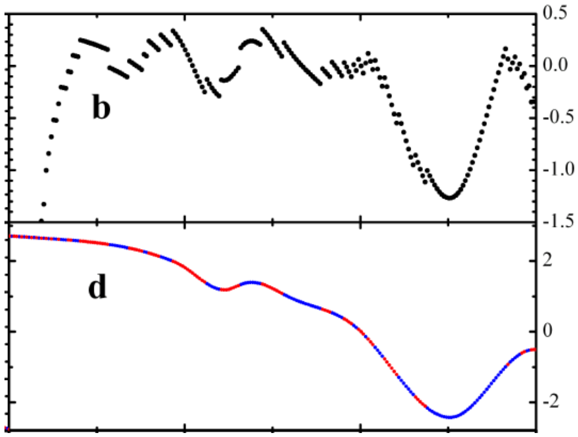


Fig. 15. Dias background subtracted data with 'jumps' of 0.1655 nV due to experimental resolution. 'Unwrapped' data where the jumps are simply moved up/down to remove discontinuities. This effectively smooths the data.

Drs. van der Marel and Hirsch's approach involves smoothing the curve P(T) and subsequently fitting it with a spline curve of a specified order. The methodology progresses to taking the derivative of P(T), identifying points where the third derivative equals zero (marked with 'x' in the figure), and fitting these points with a third-order polynomial spline, adhering to a standard set by the software Origin. This process inherently biases the outcome to produce curves that closely resemble each other, given that the selection criteria for these points predispose the analysis to such a conclusion.

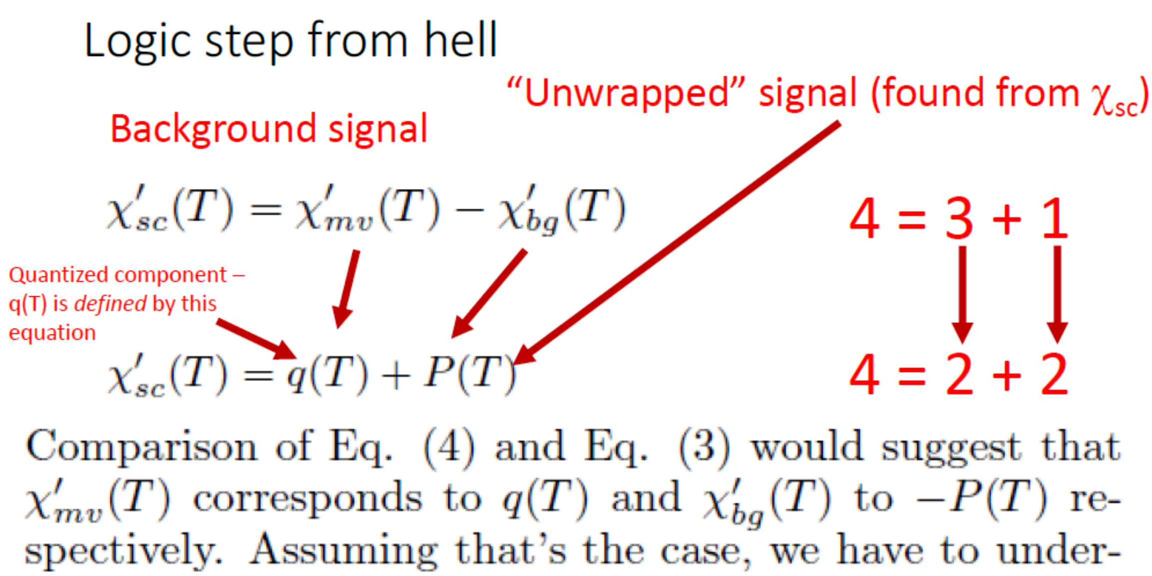


Figure 17. Hirsch's comparison. His comparison shows in a simple math example in red.

The logical foundation of their comparison, as depicted in Figure 17, between the unwrapped and quantized part of the data to the measured and background-adjusted segments, is fundamentally flawed. Their analysis fails to establish a direct correspondence between these elements, undermining the credibility of their conclusions. The assertion that q(T) must incorporate the Tc slope, while mathematically plausible, does not hold up under scrutiny when the methodology for deriving q(T) from the other components is flawed.

This examination underscores the critical need for rigorous analytical methods in scientific research. The approach taken by Drs. van der Marel and Hirsch, though seemingly methodical, exhibits a fundamental misinterpretation of the data, leading to conclusions that do not withstand critical analysis. By highlighting these flaws, I aim to provide a clearer understanding of the complexities involved in data analysis and the importance of adhering to robust, transparent, and reproducible scientific practices.

In seeking to elucidate the intricacies of data analysis and interpretation, I find it useful to draw upon the concept of the Fourier transform as an analogy, a mathematical tool that exemplifies the principles of precision and accuracy in scientific investigations. This analogy is depicted in Figure 18 below, which visually represents the process of applying a Fourier transform and its subsequent inverse transformation.

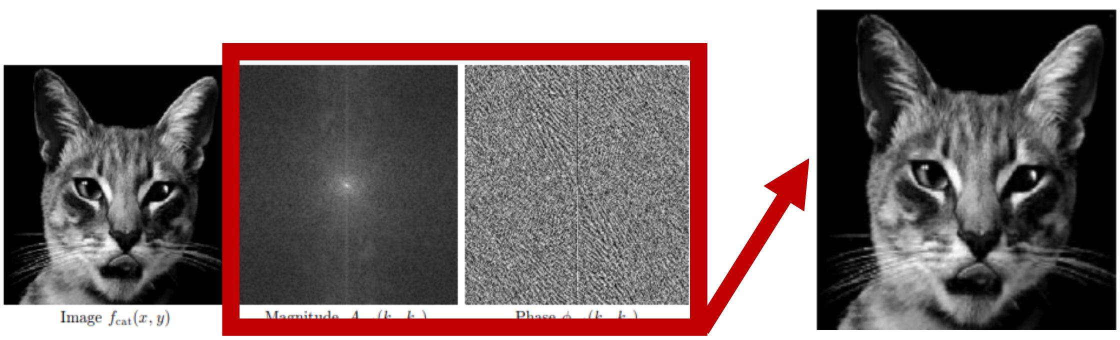


Figure 18. An analogy *for Dr. Hirsch's mathematical manipulation.*

Inverse transform

of course, you get back the cat image.

The essence of the Fourier transform lies in its ability to decompose a signal into its constituent frequencies, thereby providing a comprehensive understanding of the signal's characteristics across different domains. When we apply the inverse Fourier transform to these frequency components, we anticipate, in an ideal scenario, the exact reconstruction of the original signal. This expectation is predicated on the fundamental properties of the Fourier transform, which ensure that the operation is reversible under ideal conditions, allowing for a precise match between the original and reconstructed signals.

This analogy serves to underscore a critical point in scientific analysis: just as the Fourier transform and its inverse are expected to yield consistent and accurate results, so too should our methods of data analysis in research adhere to standards of rigor and reproducibility that allow for the faithful representation and interpretation of data. The reference to "Lecture8-FourierTransforms.pdf" from Harvard University provides a deeper insight into the mathematical underpinnings and applications of Fourier transforms, reinforcing the importance of methodological integrity.

In drawing this parallel, I aim to highlight the expectation of consistency and reliability in scientific methodologies, akin to the predictability and precision observed in the application of Fourier transforms. Just as deviations or inaccuracies in the inverse transformation process would prompt a reevaluation of the methodology or the calculations involved, so too should any discrepancies or anomalies in Drs. Hirsch and van der Marel's flawed "unwrapping" approach compel a critical assessment of their non-scientific approach.

j. The Investigation Committee's Adoption of the Flawed "Unwrapping" Approach

Delving deeper into the specifics, it's essential to critically examine the statements made in the Investigation Committee's draft report, particularly their endorsement of the analyses conducted by Drs. van der Marel and Hirsch. The report notes their ability to replicate the main elements of the analysis, which they interpret as a validation of the findings. However, this stance overlooks a crucial aspect of scientific inquiry: the mere ability to reproduce analytical steps does not inherently validate the underlying methodology or its conclusions. Replicability does not automatically rectify potential methodological flaws or inherent biases.

In addressing the concerns raised, it's necessary to scrutinize the statistical methods and arguments posited by Drs. van der Marel and Hirsch. A point of contention is their unconventional approach to statistical analysis, specifically their use of a histogram of the second difference, a technique seemingly derived from an informal source such as a Reddit comment. Such a choice raises questions about the rigor and validity of their methodology. Moreover, their assertion that a zero correlation between two variables (X, Y) implies independence is a fundamental misunderstanding of statistical principles. This misconception contradicts established statistical knowledge, which clearly states that correlation measures linear association but does not account for independence directly.

Correlation is a statistical metric that evaluates the extent of linear correlation between two variables. This relationship can be visually assessed through scatter plots, which we have included in Figure 19 for comprehensive examination. Background subtraction is utilized to refine the data presentation, ensuring that the inherent connection between the "background" and "measured data" is effectively maintained within the "signal data". This analytical step is pivotal in differentiating between lower and higher voltage readings, significantly improving signal visualization. Furthermore, the process of background subtraction, an essential technique for data analysis, aims to clarify and enhance the visual representation of data by isolating the signal of interest from the overall measurements. This technique does not alter the inherent relationship between the background and the measured data but rather ensures that the signal data is more discernible, facilitating the differentiation between lower and higher voltage readings. The examination of the plots unequivocally demonstrates a correlation, directly challenging the conclusions drawn by Drs.

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van der Marel and Hirsch and subsequently inappropriately adopted by the Investigation Committee.

To illustrate the flawed nature of their claim, we have prepared scatter plots, presented in Figure 19 below, to visually demonstrate the relationship between variables. These plots reveal the linear associations and provide a clearer understanding of the variables' interactions, countering the erroneous claims made by Drs. van der Marel and Hirsch. A careful review of the scatter plot presented below (Figure 19) will reveal that the correlation between the background and the signal (Figure 19: right) closely mirrors that between the background and measured voltage (Figure 19: left).

However, it appears there was a deliberate choice to overlook these visual demonstrations in favor of employing a less conventional approach that focuses on autocorrelation and higher-order differences. This method, while highlighting their analytical processes as complex, primarily assesses linear associations and falls short in identifying nonlinear dependencies. Such an approach may inadvertently draw public attention to the perceived sophistication of their computations, rather than a straightforward evaluation of the data's integrity. It is essential to emphasize that thorough and transparent data analysis, grounded in standard statistical practices, is fundamental to the accurate interpretation and presentation of scientific findings.

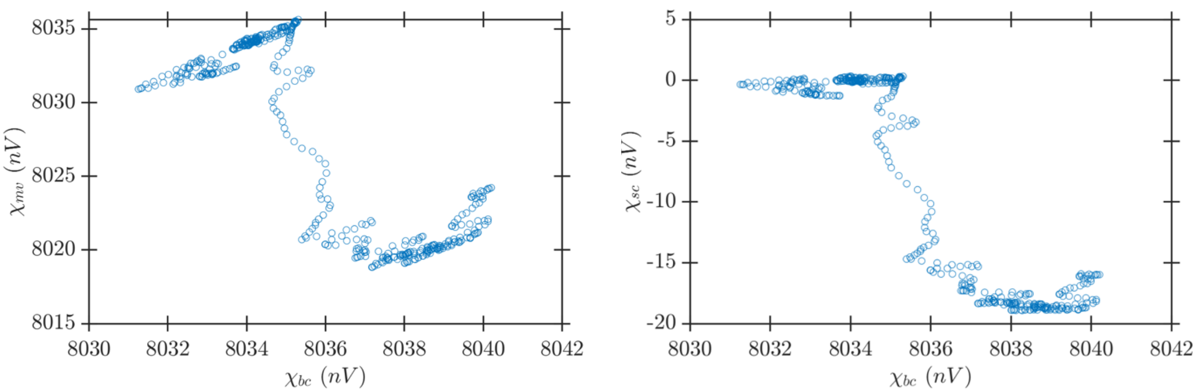


Figure 19. The scatter plots show (Top) the background data versus measured voltage data and (Bottom) background data versus published signal data.

To delve deeper into the specifics of our analysis, we focus on the evaluation of correlation functions, particularly the expectation values of the fourth derivative of susceptibility, denoted as functions $<\Delta^{(4)}\chi, \Delta^{(4)}\chi>$ - Expectations. This examination is pivotal for understanding the nuances of our dataset and the inherent relationships that underpin our scientific investigation. The formula is:

$$\chi'_{sc}(T) = \chi'_{mv}(T) - \chi'_{bg}(T)$$

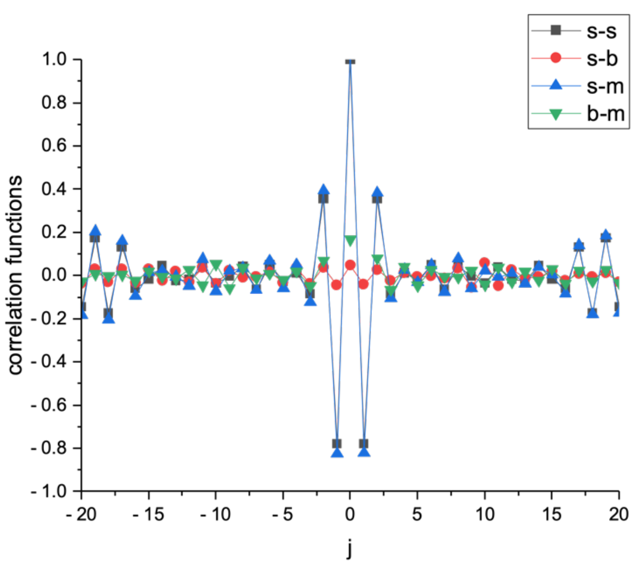
- Prof. Hirsch plots: correlations b-m, s-m, s-b and autocorrelation s-s
- Expect $\Delta^{(4)}\chi$ to be smaller than others with no rapid change near T
- Smallest should be b-m; largest should be s-s
- Value of s-m should be close to that of s-s
- Value of s-b should be a small (near that of b-m but slightly bigger)

So, I would expect to see.

$$s - s \approx s - m \gg s - b \approx b - m$$

However, Prof. Hirsh's conclusions were:

$$s - s \approx s - m \approx b - m \gg s - b = 0$$

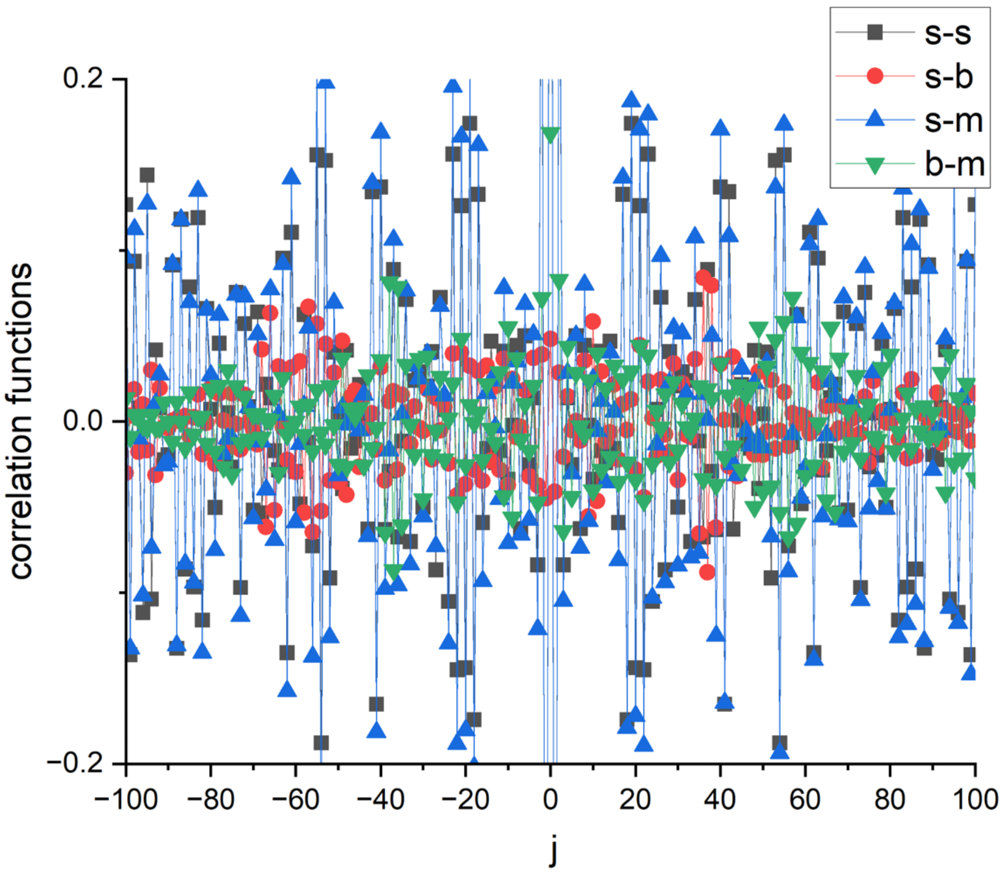


Correlations with background (bg/b) labelled b-m and s-b should be (and are) relatively small compared to s-s and s-m and shouldn't change too much near Tc (j=0). Note that on this scale s-b and b-m similar. So clearly Dr. Hirsch's assertation of $b - m \gg s - b$ is not true.

Correlations with background (bg/b) labelled b-m and s-b should be (and are) relatively small

compared to s-s and s-m and shouldn't change too much near Tc (j=0). Note that on this scale s-b and b-m similar.

Upon expanding the x-axis (temperature) and zooming in on the y-axis, we engage in a detailed analysis of the data relationships. This approach allows us to scrutinize the nuances within our dataset, as depicted in Figure 19.



s-s and s-m similar
s-b and b-m small with s-b a little bigger

Our analysis reveals that the correlations between the signal-to-signal (s-s) and signal-to-measured (s-m) data are strikingly similar. Additionally, the comparisons between signal-to-background (s-b) and background-to-measured (b-m) data indicate that while both are relatively minor, the s-b correlation is slightly more pronounced. These observations align with our initial hypotheses, thereby reinforcing the validity of our approach. As such, our expectation validated.

$$s - s \approx s - m \gg s - b \approx b - m$$

In evaluating the data, even extending to correlation analyses, we affirm the anticipated relationships. The parallel drawn in Figure 19 between the dynamics of the background and signal data, and their resemblance to the interplay between the background and measured voltage,

underscores the methodological soundness of our work. Contrary to the committee's claims, which lean on unconventional and overly complex computational methods, our findings are rooted in standardized and transparent analytical practices. The commentary offered by the committee, though presented with a veneer of analytical rigor, diverges from established statistical methodologies, potentially leading to confusion among those not well-versed in statistical or mathematical principles. It is crucial, therefore, to discern that our conclusions are derived from methodical and universally recognized analytical techniques, standing in stark contrast to the committee's approach, which lacks a solid statistical foundation.

It is understandable that the Investigation Committee may not have identified the subtleties and inaccuracies within the work of Drs. van der Marel and Hirsch, given the intricate ways in which the mathematical underpinnings and algorithmic approaches were ostensibly obscured or misrepresented throughout their analysis. In this context, it's essential to highlight certain flaws that become apparent upon a closer and more critical examination of their methodology. These issues, once brought to light, underscore the necessity for rigorous scrutiny in scientific analysis while avoiding blind adoption of flawed methodology.

First, a critical review of their use of "cubic spline" interpolation reveals a fundamental misunderstanding or misapplication of this mathematical tool. Drs. van der Marel and Hirsch claim to employ cubic splines in their analysis, which suggests a certain level of smoothness and continuity between data points. However, an in-depth examination of their computational approach indicates that they actually fit a polynomial that passes directly through every data point. Mathematically speaking, f(T_i)=\chi_i for all the considered data points (T_i,\chi_i). Therefore, asserting the use of the "cubic spline" at T_i or f(T_i) precisely indicates the utilization of the data \chi_i. This direct fitting contradicts the nuanced application of cubic splines, which are typically used to ensure a smooth and continuous curve that approximates the data points rather than intersects each one precisely.

Next, the presentation and visualization of derivative data in their analysis further demonstrate a misleading representation of the findings. By adjusting the visual scale or "zooming out" on the derivative plots, particularly at the tail end of the 160 GPa data, it becomes apparent that the argument for a smooth signal is fundamentally flawed. Despite the background subtraction technique employed to reduce noise, residual high-frequency noise persists, leading to non-smooth behavior in the analyzed signal. This observation is illustrated in Fig.20, which depicts how the quantized and smoothed aspects of the published signal data result not from the inherent properties of the sample under study but rather from the selective filtering of noise and the presence of unmitigated extreme noise artifacts.

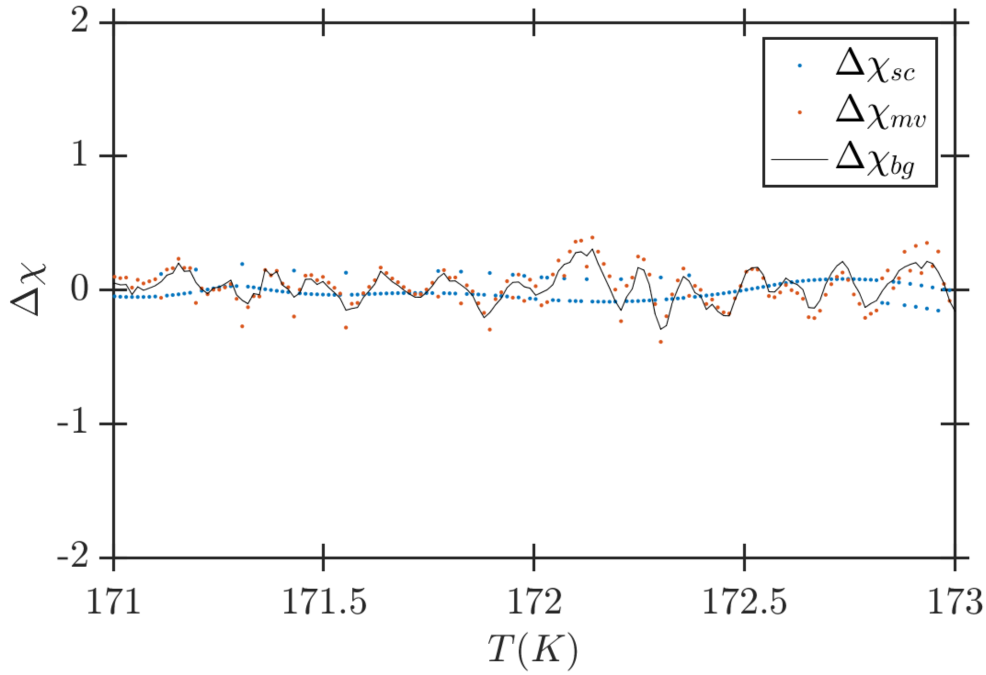
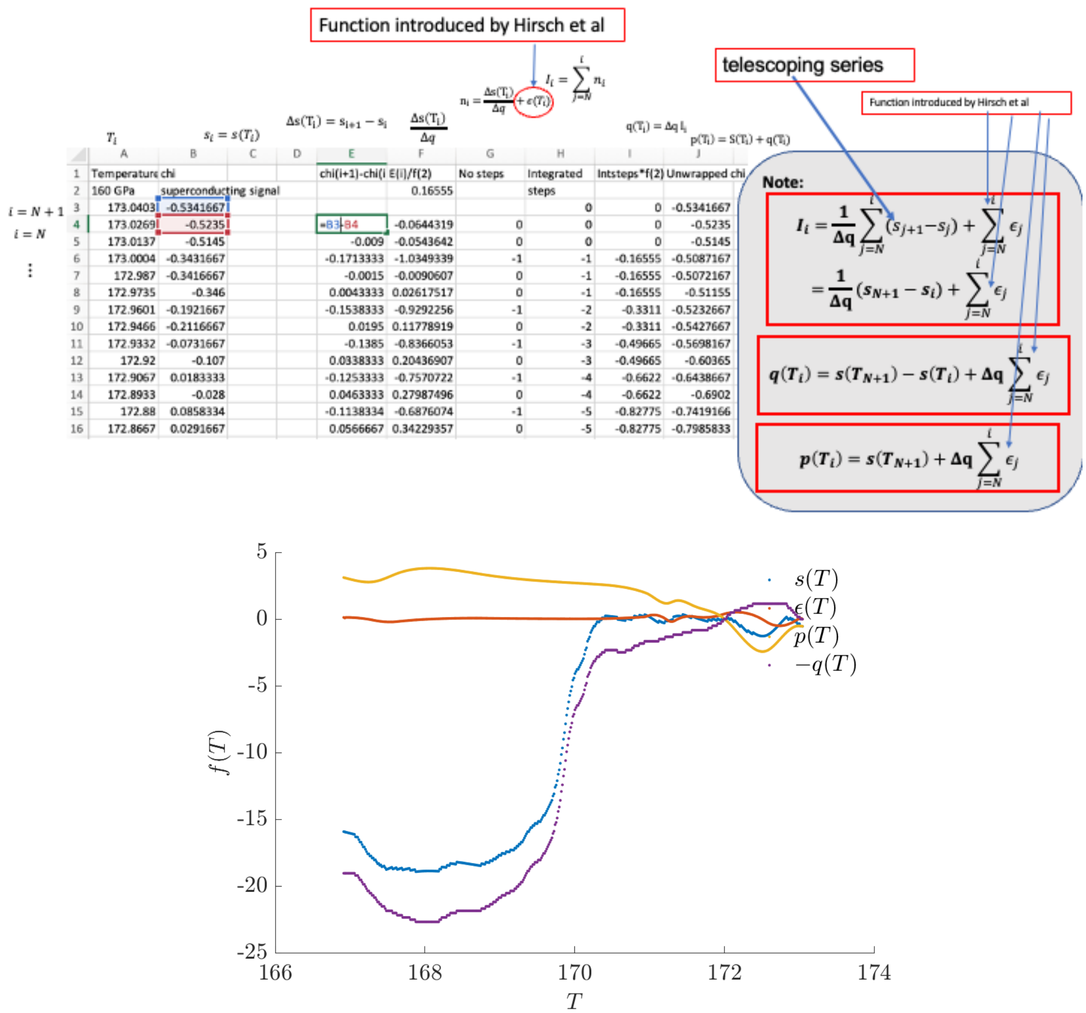


Figure 20. The figure demonstrates the zoomed-out version of the first difference of measured data (red), published signal data (blue), and background data (black) for 160GPa within the temperature range [171, 173].

These examples of methodological flaws within the work of Drs. van der Marel and Hirsch highlight the importance of transparent and accurate representation of both the mathematical framework and the analytical techniques employed in scientific research. A more detailed and careful investigation into these aspects is likely to reveal additional areas where the accuracy and integrity of the analysis may be called into question. It is through such diligent scrutiny that we can ensure the reliability and validity of scientific findings, fostering a culture of integrity and accountability within the scientific community.

In the forthcoming analysis, I aim to reveal the underlying mathematical strategies employed by Drs. van der Marel and Hirsch, as adopted by the Investigation Committee, strategies that, regrettably, appear designed to obfuscate and mislead rather than illuminate. The core of their approach hinges on the use of telescoping series, a legitimate mathematical concept which, in their application, has been manipulated to lend a veneer of credibility to their analysis. However, a closer inspection reveals that they introduce data alongside additional functions that, through the process of the telescoping series, conveniently vanish or maintain a constant value, thereby distorting the true nature of the data under examination. For clarity and ease of understanding in the critique that follows, we will adopt simplified notations as follows: T: Temperature / m(T): Measured Voltage (raw data) / s(T): Signal (data) / b(T): Background to represent the data, as illustrated in figure 21 below.



	A	B	C	D	E	F	G	H	I	J
1	Temperature	chi			chi(i+1)-chi(i	E(i)/f(2)	No steps	Integrated	Intsteps*f(2)	Unwrapped chi
2	160 GPa	superconducting signal				0.16555		steps		
3	173.0403	-0.5341667						0	0	-0.5341667
4	173.0269	-0.5235			=B3-B4	-0.0644319	0	0	0	-0.5235
5	173.0137	-0.5145			-0.009	-0.0543642	0	0	0	-0.5145
6	173.0004	-0.3431667			-0.1713333	-1.0349339	-1	-1	-0.16555	-0.5087167
7	172.987	-0.3416667			-0.0015	-0.0090607	0	-1	-0.16555	-0.5072167
8	172.9735	-0.346			0.0043333	0.02617517	0	-1	-0.16555	-0.51155
9	172.9601	-0.1921667			-0.1538333	-0.9292256	-1	-2	-0.3311	-0.5232667
10	172.9466	-0.2116667			0.0195	0.11778919	0	-2	-0.3311	-0.5427667
11	172.9332	-0.0731667			-0.1385	-0.8366053	-1	-3	-0.49665	-0.5698167
12	172.92	-0.107			0.0338333	0.20436907	0	-3	-0.49665	-0.60365
13	172.9067	0.0183333			-0.1253333	-0.7570722	-1	-4	-0.6622	-0.6438667
14	172.8933	-0.028			0.0463333	0.27987496	0	-4	-0.6622	-0.6902
15	172.88	0.0858334			-0.1138334	-0.6876074	-1	-5	-0.82775	-0.7419166
16	172.8667	0.0291667			0.0566667	0.34229357	0	-5	-0.82775	-0.7985833

Figure 21. (Top) The figure illustrates the calculation steps of Drs. van der Marel's and Hirsch's work and their utilization of telescoping series to mislead the public while concealing the signal data within the q(T) function. (Bottom) The figure visualizes the components used in the calculation. The blue curve represents the published signal data, while the purple curve depicts the q(T) function containing the data. The function p(T) used in their work (shown in yellow) is arbitrary and serves to mislead the public.

The issue at hand is not merely the application of a telescoping series per se—a concept well-regarded for its elegance and utility in various mathematical contexts—but rather the manner in which Drs. van der Marel and Hirsch have purportedly employed it. By integrating additional functions that obscure the actual dynamics and characteristics of the data, their analysis potentially misleads the reader regarding the validity and implications of the findings.

In the analytical framework presented by Drs. van der Marel and Hirsch, a critical examination reveals that the function introduced as epsilon (ϵ) possesses the flexibility to be defined as virtually any function. This characteristic, when coupled with the definition of $p(T)$ as the constant value derived from the data plus the cumulative value of the ϵ function, exposes a fundamental flaw in their methodology. Specifically, it becomes evident that while $q(T)$ encapsulates the actual data, $p(T)$ emerges as an arbitrary function, ostensibly employed to obfuscate and mislead.

Our analysis is not merely an academic exercise but serves to demonstrate the manipulative potential of the ϵ function when applied in the context of their calculations. By extending this transformation across disparate datasets, we aim to underscore the arbitrary nature of $p(T)$ and its capacity to mislead rather than clarify. To elucidate this point further, we propose to utilize (T)=(10T) with our data and Bitcoin data, incorporating the (T) used in their analysis.

a. $p(T_i) = s(T_{N+1}) + \Delta q \sum_{j=N}^{i} \epsilon_j$: no data is used. Just an arbitrary function
b. $q(T_i) = -s(T_i) + s(T_{N+1}) + \Delta q \sum_{j=N}^{i} \epsilon_j$: Data s(Ti) is included only in this function.

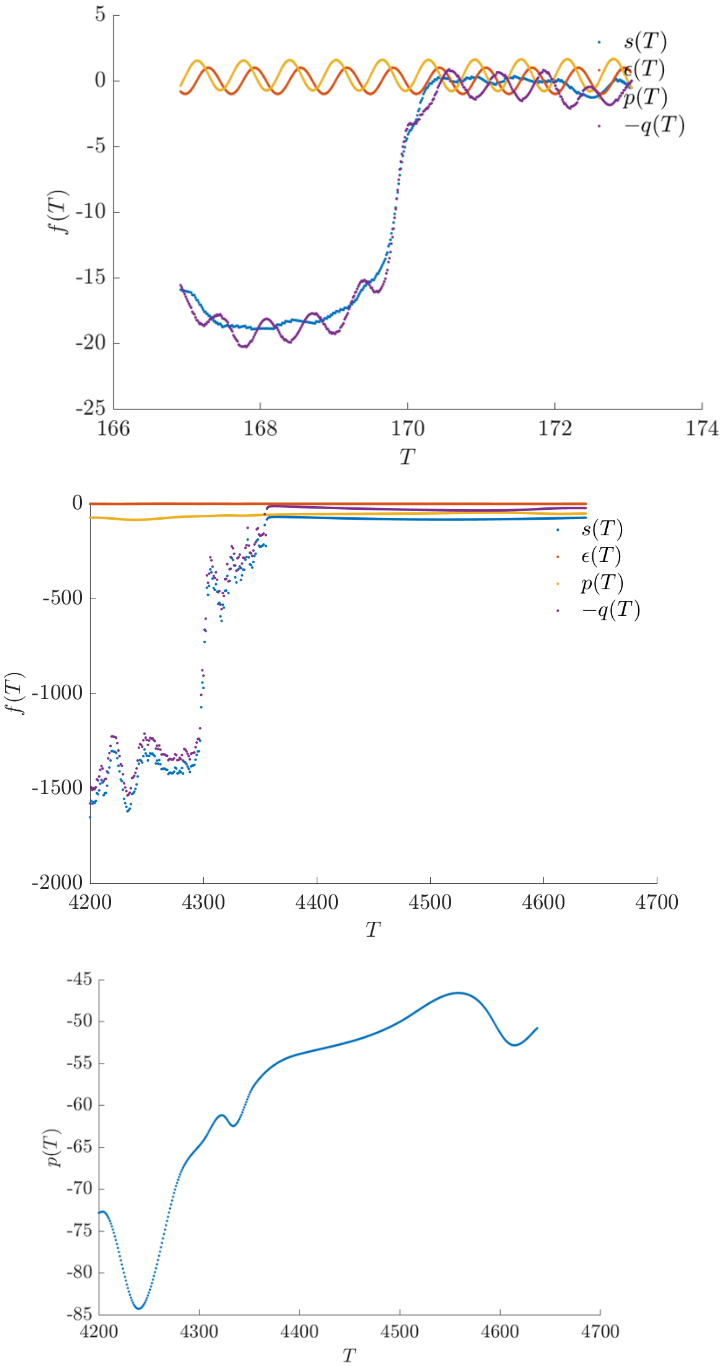


Figure 22. (Top) The figure demonstrates Drs. van der Marel's and Hirsch's misleading calculations using different arbitrary functions p(T) with measured data. (Middle) The figure demonstrates those calculations with Bitcoin market data using their original p(T) function (as shown in the bottom figure).

The allegations concerning our research trace back to what can be described as the misleading application and misuse of complex mathematical schemes by Drs. van der Marel and Hirsch. In this context, it becomes imperative to delve deeper into the intricacies of their methodologies to shed light on the fundamental flaws inherent in their algorithms, particularly those related to the manipulation of background data in relation to the signal under investigation.

Our analysis aims to dissect these methodologies, demonstrating how certain algorithmic approaches adopted by Drs. van der Marel and Hirsch, and adopted by the Investigation Committee, have led to conclusions that do not accurately reflect the underlying data. By critically examining the way in which background data has been processed and integrated with the signal data, we uncover discrepancies that suggest a misrepresentation of the data's true characteristics.

This examination is not conducted with the intent to discredit without cause but is driven by the necessity for scientific accuracy and integrity. The implications of employing 'hidden' mathematical schemes extend beyond the immediate findings; they potentially compromise the validity of the research and, by extension, the broader scientific discourse. More importantly, the Investigation Committee has blindly adopted inappropriate methodologies in support of its flawed conclusions regarding research misconduct.

To align with their notations, in this case, allow me to re-represent the previous figure as follows.

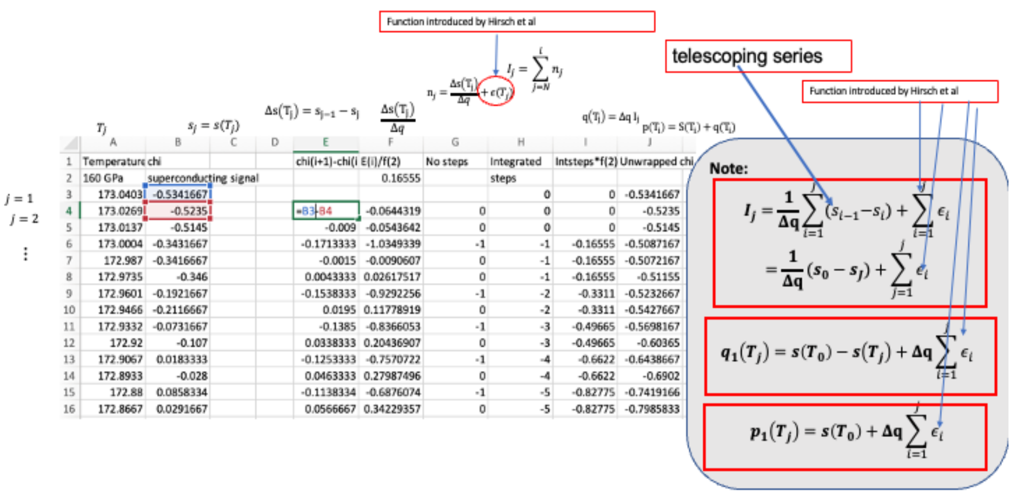


Figure 23. The figure illustrates the calculation steps of Drs. van der Marel's and Hirsch's work and their utilization of telescoping series to mislead the public while concealing the signal data within the q(T) function. This is similar to Figure 21 (Top) but rearranges the notations to match with Drs. van der Marel's and Hirsch's later paper (2022-2023).

As previously highlighted, the utilization of polynomial interpolation for estimating a point within the training set inherently yields the actual data value. This observation serves as a gateway to examining the concealed mathematical structures that underpin the allegations at hand. Polynomial interpolation, a foundational tool in numerical analysis and data science, is predicated on constructing a polynomial that precisely passes through a set of points. When applied judiciously, this method enables the accurate reconstruction of data points within the original dataset. However, the critical examination necessitated by the allegations suggests an exploration beyond the surface application of polynomial interpolation to uncover the nuanced mathematical schemes that may have been employed to mislead or misinterpret the data.

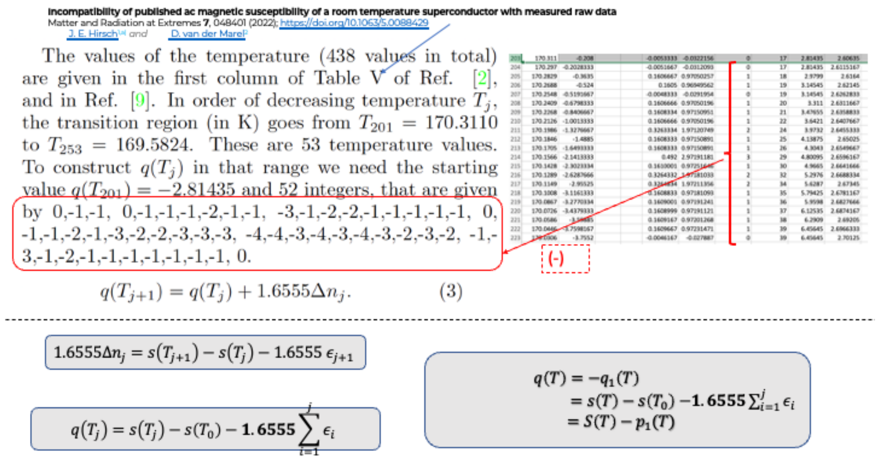


Figure 24. The figure demonstrates the calculation steps of Drs. van der Marel's and Hirsch's work and their utilization of telescoping series to mislead the public while concealing the signal data. They attempt to present this as a brand-new process and hide the signal data under the q(T).

The assertion made by the authors under scrutiny is that the aggregate of background data alongside the $p(T)$ and $q(T)$ components amalgamates to form what is presented as the published data, yet they contend that this does not include any actual measured voltage. This claim is articulated through the equation $NMV(T)=USB1(T)+q(T)+p(T)$, wherein the notation $USB1$ utilized in their publication is referenced as $b(T)$ in our discussion. Through a series of calculations, as illustrated in preceding figures, they effectively nullify the superfluous terms within this equation, resulting in:

$$NMV(T)=USB1(T)+q(T)=USB1(T)+s(T)-p1(T)=m(T)-p1(T)$$

This simplification follows from the premise that $s(T)=m(T)-USB1(T)$, where $s(T)$ represents the signal adjusted for background, and $m(T)$ denotes the actual measured voltage.

Critically, if the arbitrary function $p(T)$, as previously discussed, is set to mirror the $p1(T)$ arbitrary function derived through their methodology, then $NMV(T)$ directly corresponds to the measured voltage $m(T)$. This maneuver—aligning $p(T)$ with $p1(T)$ effectively ensures that $NMV(T)$ aligns with $m(T)$, the actual measured voltage, a technique they appear to have employed, as evidenced by the analysis presented in Figure 25 below.

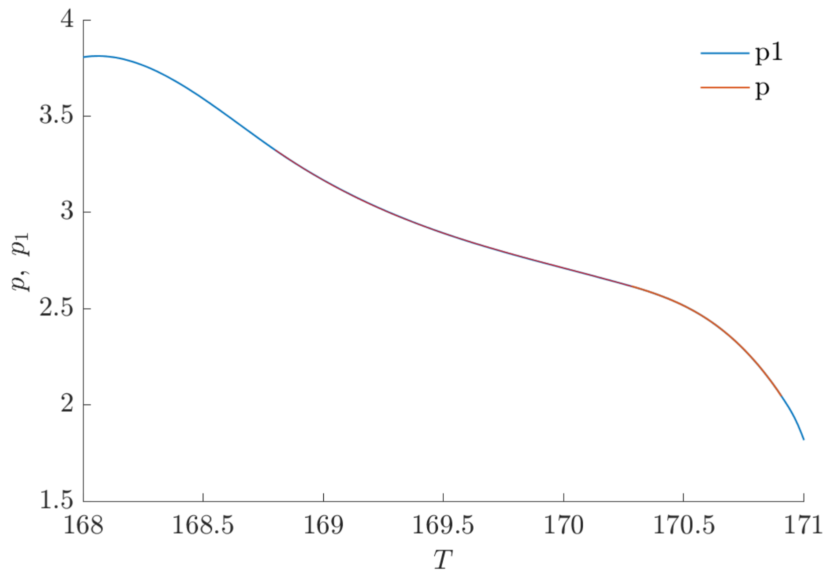


Figure 25. The figure demonstrates that the p(T) function and the p_1(T) function are identical. Both of these arbitrary functions are introduced by Drs. van der Marel and Hirsch. One function (P) is constructed through a cubic spline process, while the other (P_1) is introduced to balance the telescoping series. Then, one is added while the other is subtracted from the measured data to mislead the reader.

The allegations at the heart of this discourse stem from actions by individuals deeply invested in embedding sophisticated mathematical constructs within data, ostensibly to serve personal agendas under the guise of scientific inquiry. This situation transcends the bounds of mere data analysis; it challenges the very principles of experimental science, which fundamentally relies on the reproducibility and integrity of results. Contrary to the claims of these allegations, experimental outcomes akin to ours are not confined to the theoretical realm but are readily replicable in any suitably equipped laboratory worldwide. Our methodology does not solely hinge on the manipulation of background voltage data to amplify the signal; it stands on the robustness of experimental evidence, inviting scrutiny and replication as the bedrock of scientific validation.

In summarizing the concerns raised throughout this discourse, it becomes evident that the methodologies employed by Drs. Hirsch and van der Marel are characterized by a level of complexity that appears to serve no purpose other than to confound and obscure. Their methodological choices, particularly the adoption of an 'unwrapping' technique to segment the superconducting signal, reflect a broader strategy of data manipulation. This technique, while potentially applicable to any data set marred by noise, raises significant questions about the specificity and legitimacy of their analytical claims. Moreover, their calculated use of scaling factors and selective data ranges to support their hypotheses not only undermines the integrity of their analysis but also suggests a predisposition towards confirming pre-established beliefs at the expense of empirical objectivity.

Adding to these concerns is the Investigation Committee's endorsement of Drs. Hirsch and van der

Marel's flawed approach. The committee's failure to critically assess the validity and applicability of the methodologies in question is troubling. It indicates either a concerning lapse in due diligence or a substantial misunderstanding of the scientific principles at play. The committee's uncritical adoption of these methodologies not only legitimizes questionable analytical practices but also sets a precarious precedent for future investigations. By aligning themselves with a framework that prioritizes obfuscation over clarity, the committee inadvertently contributes to the propagation of scientific methodologies that lack transparency and rigor.

k. Replication Supports the Validity of our C-S-H Data and Findings.

In response to claims of data fabrication related to superconductivity, it is essential to consider the fundamental question of how supposedly fabricated data could have been independently replicated and demonstrated in front of numerous scientists at a prominent national laboratory (APS) and subsequently shown to exhibit a superconducting gap for the first time at another national laboratory i.e. Brookhaven Lab. Presented below are the results of multiple measurements conducted on the synthesized carbonaceous sulfur hydride (C-S-H) superconductor, characterized by a remarkably high Tc at lower pressures, employing advanced techniques:

> *Compositional Tuning of Tc*: The synthesis of the C-S-H material was facilitated through the previously described method of compositional tuning of Tc. A modulated AC susceptibility technique was applied to identify the onset of superconductivity. The results unveiled a superconducting transition at approximately ~260 K at 133 GPa for a C-S-H sample. This pressure threshold is significantly lower pressure for reaching the same Tc compared to that found in the original syntheses, indicating the adaptability of the material to lower pressures (refer to Figure 2).
>
> *Synchrotron IR Measurements*: Synchrotron IR measurements in the energy range of 70 to 170 meV were conducted on the same C-S-H sample. These measurements revealed a sharp decrease in reflectivity below Tc compared to the normal state at temperatures below 100 K. The observed superconducting gap measured approximately ~85 meV at 100 K. This value closely aligns with the BCS theoretical prediction of approximately ~80 meV for a T_c of 260 K, reinforcing the conventional nature of superconductivity.
>
> *Structural Analysis*: To gain further insights, the structure of the superconducting phase was directly probed through synchrotron single-crystal x-ray diffraction, concurrently with the measurement of the Meissner effect using AC susceptibility. These independent experiments not only confirmed the very high Tc previously identified in the C-S-H system at higher pressures but also provided valuable structural information.

In summary, these findings underscore the robustness and reproducibility of the data, supported by experiments conducted at renowned national laboratories. The comprehensive nature of these investigations further validates the legitimacy of the scientific work in question.

The direct measurement of a material's magnetic behavior during its transition into the superconducting state, particularly the expulsion of external magnetic fields, plays a pivotal role in confirming the presence of superconductivity. To achieve this, a commonly employed setup utilizes two coils: one generates an AC magnetic field (referred to as the "primary/excitation coil"), while the other detects the magnetic field by measuring the induced voltage (referred to as the "secondary/pickup coil"). Placing the sample in the middle of these coils results in an induced electromotive force (voltage) that is proportionate to the average magnetic susceptibility of the volume encompassed by the coil. This, in turn, is directly related to the magnetic susceptibility of the sample under constant conditions. This fundamental approach is commonly referred to as the signal-frequency AC susceptibility method.

In practical applications, variations in environmental conditions introduce complexities that lead to a residual background voltage. These variations arise from geometric disparities between coils, non-symmetrical deformations of the coils due to temperature fluctuations, and the non-uniform magnetic flux stemming from the metallic components within the Diamond Anvil Cell (DAC). Such complexities can obscure the detection of the superconducting transition due to the presence of a non-zero, temperature-dependent background signal.

To enhance the sensitivity of the technique for samples of DAC-scale dimensions, a double-frequency method has been introduced. In this method, the superconducting state at the onset of the transition is intentionally suppressed through the application of another high-amplitude modulation. This technique capitalizes on the critical field behavior characteristic of superconductors. Specifically, the excitation field, which is much smaller and at a higher frequency, is employed to measure the diamagnetic change in the sample. Meanwhile, the modulation field operates at a lower frequency and boasts greater strength compared to the excitation field. Within a small temperature range, the modulation field surpasses the critical field, leading to the suppression of the superconducting state at twice the modulation frequency. This suppression occurs at both the peak and trough of the modulation field, providing valuable insights into the superconducting behavior of the material under examination.

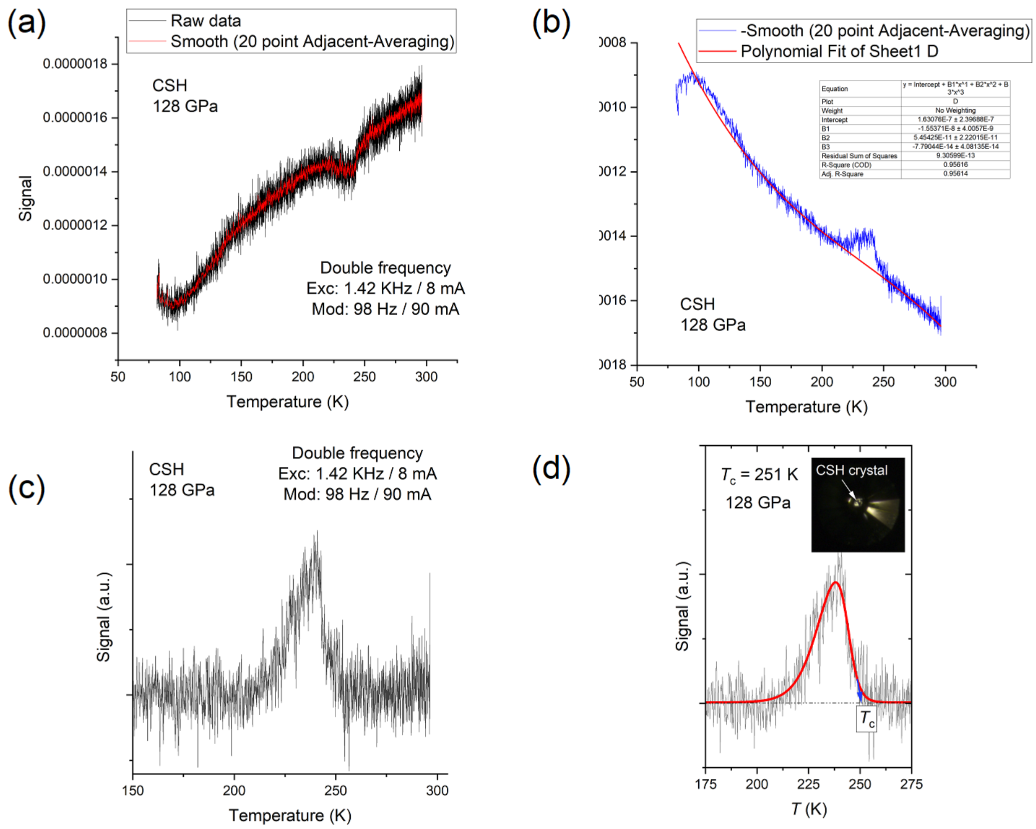


Figure 26. Modulated AC magnetic susceptibility measurements of carbonaceous sulfur hydride at 133 GPa showing the clear peak as the sample enters the superconducting state with maximum T_c of 260 K at 128 GPa. The blue arow indicates the superconducting transition temperature.

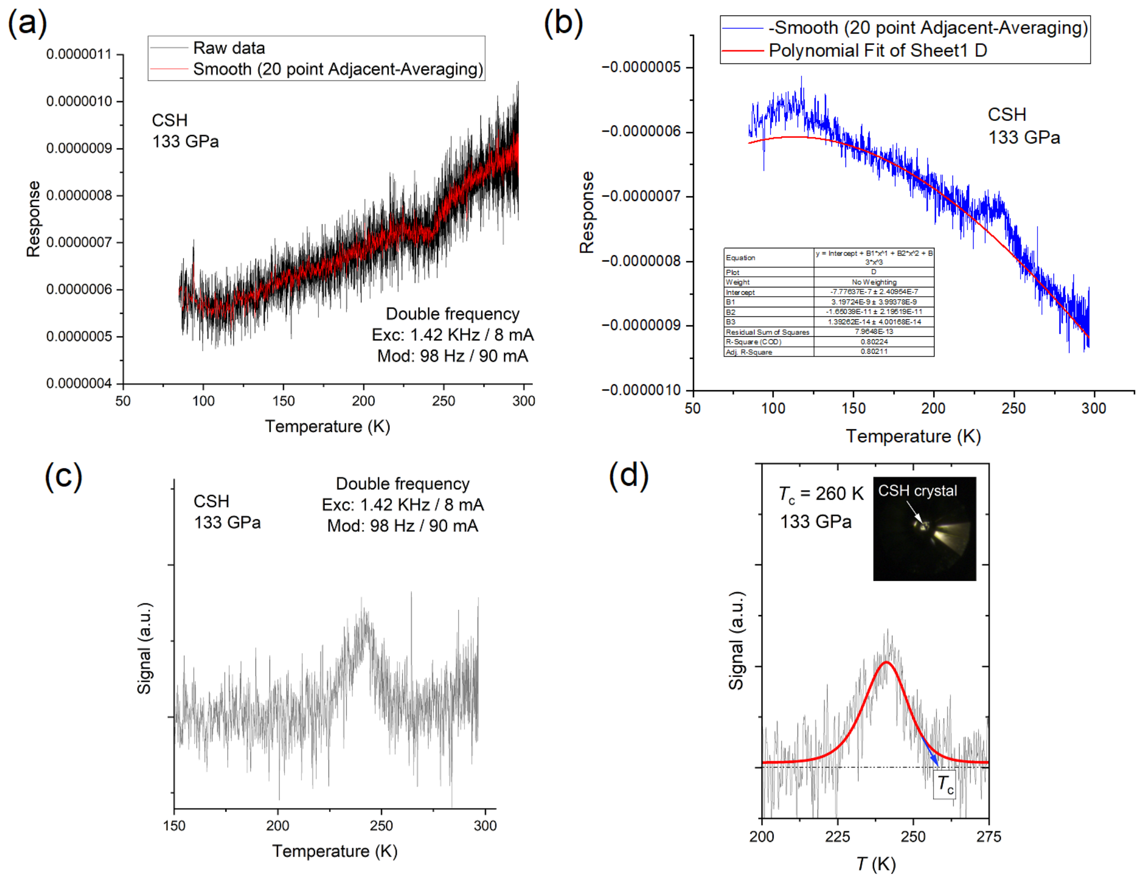


Figure 27. Modulated AC magnetic susceptibility measurements of carbonaceous sulfur hydride at 133 GPa showing the clear peak as the sample enters the superconducting state with maximum T_c of 260 K at 133 GPa. The blue arow indicates the superconducting transition temperature.

Synchrotron infrared (IR) spectroscopy has been instrumental in unraveling the superconducting characteristics of the C-S-H phase within its superconducting state, an event concurrently monitored by AC susceptibility measurements that revealed a transition occurring at 260 K under a pressure of 133 GPa. These findings present a notable contrast to the infrared measurements conducted on H3S, which primarily focused on the mid-IR spectra, collected using a conventional IR source. That paper also includes discussion related to the low-energy spectral range and the superconducting gap. It is worth noting that while the utility of a synchrotron source was considered, the data utilized for the analysis were derived from measurements made with a conventional source.

The measured superconducting gap, approximately ~85 meV at 100 K, aligns remarkably well with the theoretical predictions of the BCS theory, which postulates a gap energy of $2\Delta(0) = 3.528k_BT_C$; with T_c of 260 K. Notably, the independently measured Tc value of 260 K, determined

through magnetic susceptibility measurements, yields the calculated superconducting gap ($2\Delta(0)$) ~80 meV. This striking alignment with the BCS prediction lends strong support to the notion of conventional superconductivity, even in the presence of an exceptionally high critical temperature (Tc).

In this research endeavor, we have undertaken a comprehensive examination of specific C-S-H samples, affirming the validity of our measurement techniques for determining the superconducting transition temperature and corroborating previously established methodologies. Our selection of a particular C-S-H compound, one that can be synthesized under lower pressures, has enabled us to focus our investigations on magnetic susceptibility measurements pertaining to the Meissner effect. Additionally, it is important to note that within the realm of C-S-H, there exist higher pressure structures and compositions, as demonstrated by the work of Snider et al., who conducted measurements of electrical conductivity and magnetic susceptibility, ultimately unveiling the existence of a room temperature superconductor within this compound.

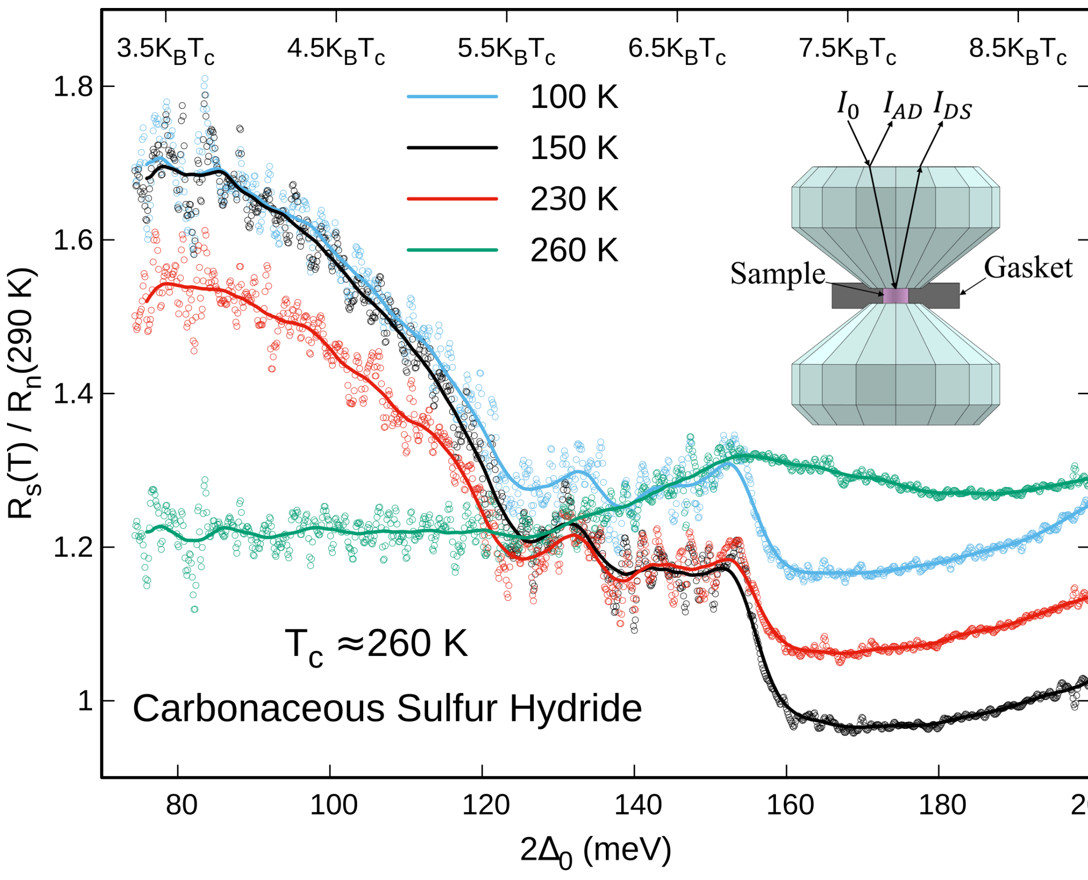
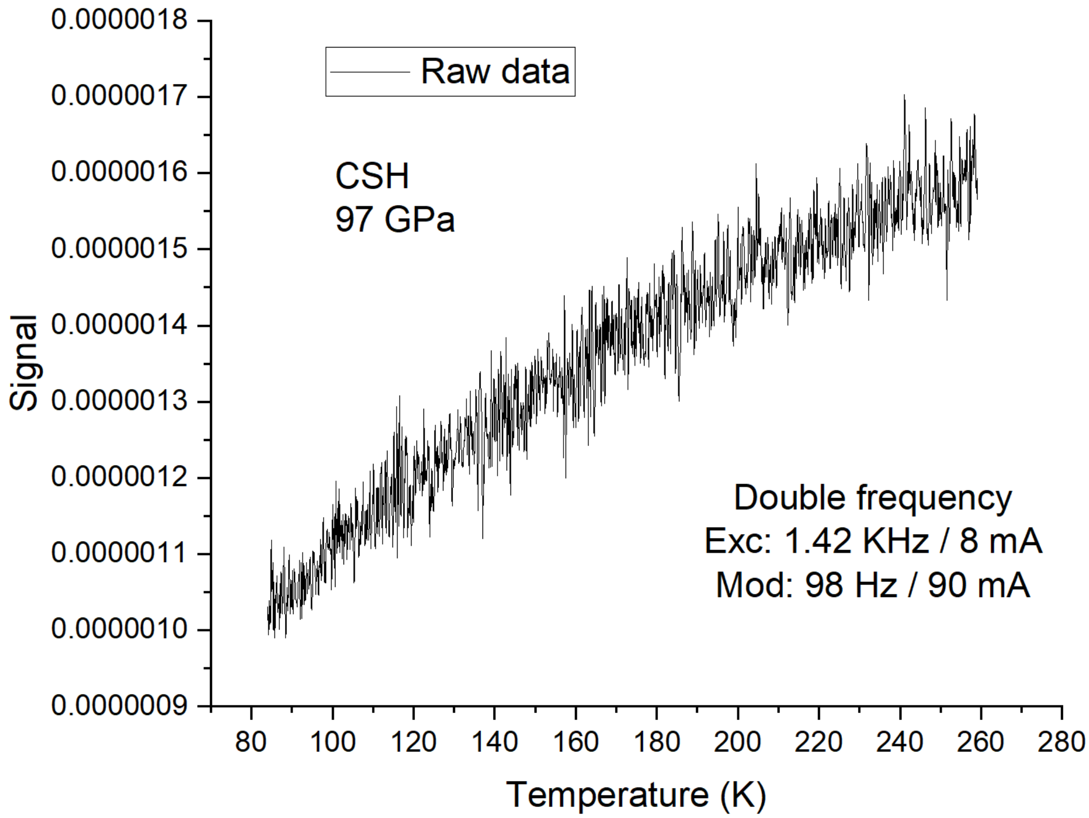


Figure 28. Synchrotron infrared reflectivity of the C-S-H superconductor. The $R\,(T)/R_n$ curves for 260 K, 230 K, 150 K and 100 K, with 290 K (normal state) as the reference. The results give a maximum superconducting gap for the C-S-H sample of ~85 meV at 100 K and 133 GPa. The inset shows the schematic of the ray diagram for reflectivity measurements.

A null signal, at 97 GPa. No superconductivity was observed.



l. Conclusion.

In conclusion, the journey through the labyrinth of accusations, misunderstandings, and methodological critiques has been both challenging and illuminating. From the outset, it has been my steadfast objective to clarify the integrity and scientific validity of our research, particularly in light of the accusations concerning the fabrication and falsification of $\chi(T)$ data. The process has necessitated a deep dive into the complexities of A.C. susceptibility measurements, the nuances of high-pressure superconductivity research, and the broader implications of scientific methodology and data analysis.

The misunderstanding surrounding the application of the A.C. susceptibility method and its relation to the Meissner effect represents a fundamental misinterpretation of our research objectives and outcomes. It is crucial to reiterate that our approach was designed with precision and adherence to established scientific principles, aiming to provide insightful contributions to the field of superconductivity research rather than to mislead or fabricate evidence of superconducting phenomena.

Our response to the Investigation Committee's concerns has also underscored the importance of

context and custom in the presentation of scientific data. The expectation for unprocessed data publication, while relevant in certain scientific disciplines, does not necessarily align with the specialized requirements and practices of high-pressure superconductivity research. It is through the lens of this specialized knowledge that our data presentation strategies should be evaluated. Furthermore, the unanimous consensus among nine esteemed scientists, affirming the absence of any data fabrication or manipulation, serves as a testament to the credibility and rigor of our research. This endorsement, unfortunately overlooked by the Investigation Committee, underscores the foundational integrity of our work and the respect it garners within the scientific community.

The critique of the analytical methodologies employed by Drs. van der Marel and Hirsch, and subsequently adopted by the Investigation Committee, highlights the critical need for scientific scrutiny and methodological integrity. The reliance on flawed analyses to substantiate accusations of misconduct not only undermines the credibility of the investigative process but also detracts from the constructive discourse necessary for scientific advancement.

As we move forward, it is my sincere hope that this detailed response serves not only as a rebuttal to the accusations leveled against our research but also as a contribution to the ongoing dialogue on scientific integrity, methodological transparency, and the pursuit of knowledge. The challenges we have faced underscore the importance of rigorous scientific inquiry, peer review, and the collective endeavor to expand our understanding of the natural world.

In the spirit of scientific progress and collaboration, I invite further discussion, scrutiny, and verification of our findings. It is through such open and constructive engagement that we can all move closer to the truth, bolstered by a shared commitment to integrity and excellence in research. Let us continue to question, to explore, and to innovate, always with an eye towards the betterment of our collective scientific understanding.

4. The 138 GPa Inset in Extended Data Figure 7d Was Not Falsified.

Regarding the Investigation Committee’s discussion about the methodologies applied in our CSH research, specifically pertaining to the background signal analysis, it is important to clarify the distinction between the terms "determined from" and "used," as these have become focal points of the Investigation Committee’s misinterpretation and misunderstanding.

First, the phrase "determined from" can be used in various contexts to describe a process of arriving at a particular conclusion, result, or value based on the analysis, evaluation, or interpretation of specific data. The use of the phrase “determined from” was intended to demonstrate an analytical process where we examined various data to identify a baseline from which we could develop the appropriate background subtraction. This approach was intended to convey a methodological approach where the outcome is not merely assumed or directly observed but is inferred through a series of logical, statistical, or computational steps. The use of the word “determined” conveys a sense of finality about the outcome, indicating that it has been ascertained through careful consideration or analysis. From our perspective, the use of the phrase “determined from” represents a process where various possibilities were considered, but ultimately, one specific

outcome was established i.e. a baseline for the background signal based on various considerations of data related to the non-superconducting signal at 108 GPa.

On the other hand, unlike "determined from," which implies a derivation or extraction process through analysis, "used" does not inherently suggest that the 108 GPa data underwent further analysis to yield additional insights or conclusions. Instead, it indicates that the data, as it is, was sufficient for the purpose it served in the research. Stated another way, the usage of "used" points to the data being employed in its existing form or state. That would have implied that the 108 GPa data was not specifically analyzed to derive new data points or insights for the purposes of our research. That was not the case with our research which is exactly why we did not state that the background was “used” from 108 GPa.

Instead, in our research of CSH careful consideration was given to the language used to describe the methodologies and processes, particularly regarding the handling of the 108 GPa data. The decision not to state that "108 GPa was used" was a deliberate and thoughtful choice, aimed at ensuring the utmost accuracy and integrity in our representation of the data and its application in the context of background subtraction. This choice was grounded in the necessity to avoid any potential misinterpretation that the 108 GPa data was directly applied or utilized in its raw form as a part of our analysis. Instead, the data obtained at 108 GPa served a distinct and crucial role in informing our understanding and derivation of an appropriate background signal. This nuanced approach allowed us to accurately delineate the process by which we calculated and adjusted the background signal, ensuring that our analysis reflected a precise and methodologically sound use of data. By refraining from using the phrase "108 GPa was used," we preserved the integrity of our research methodology, accurately conveying the complex and rigorous analytical processes that underpinned our study, thereby ensuring clarity and preventing any misrepresentation of our data handling and analytical strategies.

Contrary to the Investigation Committee’s interpretation of the words we used, the decision to employ the phrase "determined from" in describing our approach to deriving an appropriate background subtraction methodology was meticulously considered to precisely convey the depth and rigor of our analytical process. This choice of terminology underscores the comprehensive evaluation and interpretation that was undertaken with the data identified at the non-superconducting signal at 108 GPa. It signifies that the background signal was not merely used in a straightforward manner but was the result of a methodical and detailed analysis aimed at understanding its characteristics and how it could inform the subtraction process. By stating that the background was "determined from" the 108 GPa data, we emphasize the scientific diligence and analytical rigor applied in extrapolating the necessary parameters for accurate background subtraction. This phrasing accurately reflects the complex process of data analysis, indicating that the derived background signal was the outcome of a thoughtful examination of the data's underlying behaviors and properties. It conveys our commitment to precision and reliability in our research, highlighting that the conclusions drawn were based on a solid foundation of evidence and analytical reasoning. This careful choice of words thus supports the transparency and integrity of our methodology, reinforcing the credibility of our findings and the scientific value of our work.

It is imperative to understand that our choice of terminology in the manuscript was made with careful consideration to accurately reflect the methodology employed. The distinction between

"determined from" and "used" is not merely semantic but fundamental to understanding the rigor of our analytical process.

Furthermore, it is essential to recognize that scientific discourse requires precision in language to convey complex methodologies and interpretations accurately. The suggestion that the choice of a specific term could imply data fabrication or falsification is a misunderstanding of the scientific process. Our research adheres to the highest standards of scientific integrity, and our use of terminology is reflective of the meticulous and thorough approach we take in our analyses.

Therefore, it is clear that the use of "determined from" in our documentation is not only appropriate but necessary to convey the analytical process undertaken to establish the background signal. This clarification should dispel any misconceptions regarding our methodology and affirm the validity of our research findings.

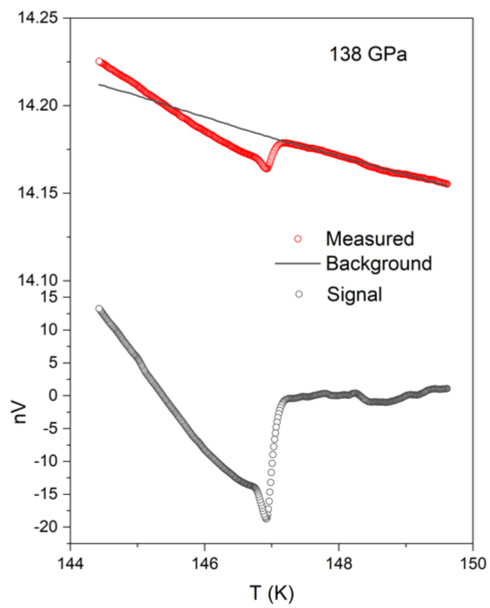


Figure 1. The AC susceptibility data from Snider et al., showing the raw data, the background used for subtraction and the data shown in the publication.

In direct response to the Investigation Committee's repeated and duplicitous references regarding the presentation of data in Extended Data Figure 7d, I wish to clarify our position and address the issue in a manner that reflects both the professionalism and the integrity of our research. It has been noted that the figure in question was mistakenly labeled as representing raw data when, in fact, it had undergone background subtraction. This discrepancy was identified early in our communications with the journal Nature and was also discussed during an interview with the Investigation Committee. The oversight regarding the figure caption was immediately acknowledged as an unintentional error (or merely a typo) on our part, and corrective steps were taken to inform all relevant parties, including the Committee Chair. Just to make it clear, Figure 1 shows the raw data for 138 GPa (in red) and the background-subtracted data (in black). I am confounded by the conclusion that such an innocent oversight could be deemed data fabrication and/or data falsification.

Moreover, it is crucial to acknowledge that the issue in question was one of several typographical and minor linguistic inaccuracies identified within our submission. While these errors are unfortunate, they do not compromise the scientific integrity of our work nor imply any misconduct in our research methodologies. It is a well-recognized aspect of scholarly communication that minor errors can occur, which are typically addressed in subsequent revisions. In this instance, the error was limited to a single word. Notably, none of the peer reviewers who evaluated our work raised any concerns regarding these issues, indicating a clear understanding that such typos are common occurrences in scientific documentation.

I must emphasize that the allegations of data falsification or fabrication are unwarranted and without merit. The raw data for 138 GPa, alongside the background-subtracted data, have been transparently presented and are available for scrutiny. These representations clearly demonstrate the rigor and accuracy of our analytical processes.

The repeated focus on these issues, despite our proactive efforts to correct and clarify, suggests a misalignment in communication rather than a substantive fault in our research methodology or ethics. Our team remains committed to upholding the highest standards of scientific integrity and transparency. We trust that this explanation suffices to dispel any concerns regarding our adherence to these principles and to move the discussion forward in a constructive manner.
The allegations of data falsification or fabrication are, therefore, unfounded and do not reflect the reality of our research practices. The transparency with which the raw and background-subtracted data have been presented affirms the integrity of our analytical processes and the validity of our results. Our proactive engagement with the journal and the Investigation Committee, aimed at clarifying any misunderstandings and correcting errors, demonstrates our commitment to the highest standards of scientific integrity and transparency.

In conclusion, the scrutiny applied to our choice of words and the subsequent misinterpretations highlight the critical importance of precise language in scientific discourse. However, it also underscores a need for a more nuanced understanding of the complexities involved in scientific analysis. Our adherence to these principles throughout our research process reaffirms the credibility of our findings and our dedication to contributing valuable knowledge to the scientific community. We trust that this detailed explanation clarifies our methodological choices and dispels any concerns regarding the integrity of our work.

1. The R(T) Data (Resistance as a Function of Temperature) Was Not Fabricated nor Falsified.

I appreciate the opportunity to respond to the allegations presented by the Investigation Committee regarding the supposed fabrication and falsification of R(T) data in our Nature 2020 publication. These accusations are both serious and damaging, and it is imperative that a clear, factual, and scientifically grounded counter-narrative is provided to address each point of contention. The Investigation Committee's accusations of data fabrication and data falsification are unfounded and not supported by any substantive evidence. Instead, the Investigation Committee's conclusion is premised upon speculation and conjecture intended to support an outcome driven conclusion.

a. The Investigation Committee's Adoption of James Hamlin's Claims Are Misplaced and Does Not Reflect an Independent Neutral Investigation by the Investigation Committee.

In the context of the allegations made against me, the accusation in question is both perplexing and unfounded. The essence of an Investigation Committee's mandate is to serve as an impartial entity, tasked with conducting an independent and neutral analysis of all aspects related to the case at hand. This includes not only a thorough examination of the accused party's work but also a critical review of third-party contributions, such as those made by James Hamlin in this instance. The ultimate objective of the committee should be to arrive at its own conclusions, grounded firmly in scientific analysis and evidence, rather than merely reflecting or amplifying external opinions.

The foundational principle guiding the Investigation Committee's operations should be the pursuit of truth through a balanced and objective assessment of all available data. This process necessitates a deep understanding of the scientific context, the methodologies employed, and the nuances that might influence the interpretation of results. It is concerning that the committee appears to have leaned heavily on the interpretations offered by third parties without independently verifying the claims or considering the full breadth of evidence. Such an approach undermines the committee's role as an arbiter of scientific integrity and questions the thoroughness of its investigative process.

The reliance on external sources, without presenting any direct evidence of data fabrication or falsification, suggests a departure from the committee's core responsibilities. An effective investigation should not only scrutinize the accused's work but also equally evaluate the credibility and relevance of the assertions made by critics like James Hamlin. It is essential for the committee to differentiate between genuine scientific discrepancies and subjective interpretations, ensuring that its conclusions are not merely an echo of existing sentiments but rather a reflection of an exhaustive and impartial scientific inquiry.

In summary, the Investigation Committee's charge is of critical importance to maintaining the integrity of the scientific process. It is incumbent upon the committee to undertake a comprehensive and unbiased examination of all claims, leveraging its expertise to discern the validity of the data in question. The goal should be to foster an environment where scientific truth prevails, supported by evidence and rigorous analysis rather than by the uncritical acceptance of third-party opinions.

b. The Investigation Committee Has Access to Comprehensive Raw Data.

The assertion posited by the Investigation Committee, suggesting a failure on my part to provide raw data for their review, requires clarification to accurately reflect the situation. Throughout my professional career, the foundational principles of integrity and transparency in my research have been consistently upheld. It is a well-established norm within our scientific community to disseminate research findings in various formats, tailored to the context of their intended use, including the presentation of processed data in the form of publication-ready figures—a practice diligently followed in this instance.

To elaborate, the Investigation Committee was granted unfettered access to all pertinent raw data alongside the comprehensive suite of resources integral to my research endeavors funded by NSF and DOE. This access encompassed an extensive array of materials and tools, including but not limited to, office and laboratory equipment, computers, lab notebooks, and the entirety of the research data accumulated over the course of my studies. Such provision was made in earnest to facilitate a thorough and unimpeded examination of the work under scrutiny.

The notion that the provision of finished figures somehow constitutes a withholding of raw data represents a fundamental misunderstanding of the data analysis and presentation methodologies inherent to our field. The transition from raw data to finished figures is a critical component of the scientific process, involving rigorous analysis and interpretation to distill complex datasets into comprehensible and informative visual representations. This process does not, in any manner, detract from the availability or the integrity of the raw data itself, which remains fully accessible and was explicitly made available to the Committee for their review.

In light of these considerations, it is important to underscore that the commitment to transparency and the adherence to established scientific practices have been meticulously observed, ensuring that the Investigation Committee has all the necessary information and resources at their disposal to conduct a comprehensive and informed evaluation of the research in question.

c. Data Was Collected and Maintained by Multiple Researchers and Scientists.

The observed inconsistencies in the narratives concerning the locales and methodologies employed in the measurement of R(T) data can be more accurately attributed to instances of miscommunication rather than any deliberate attempt to mislead. The infrastructure required for conducting these measurements was distributed across a collaborative network encompassing our research group, incorporating facilities not only within our primary university but also extending to external institutions such as UNLV. Given the inherently complex nature of high-pressure experimental research, which frequently necessitates the utilization of varied sites and instrumentation, it is not uncommon for ambiguities to arise regarding the precise origin of specific datasets. Such instances should not be hastily interpreted as deliberate falsifications.

This nuanced understanding of the research environment highlights a significant oversight on the part of the Investigation Committee, specifically its failure to thoroughly evaluate the roles and responsibilities of various scientists involved in the data collection and storage processes. The collective effort required to undertake this caliber of scientific investigation demands a coordinated approach to data management, wherein each contributor's role in generating, collecting, and archiving data is clearly defined and acknowledged.

The lack of critical assessment by the Committee regarding how data were managed and preserved by different members of the research team overlooks a crucial aspect of collaborative scientific endeavors. Effective data governance in such contexts relies on the collective responsibility of all contributors, necessitating a clear delineation of duties and protocols for data handling. The Committee's oversight in this area suggests a gap in their understanding of the operational dynamics within complex, multi-site research collaborations, potentially leading to an incomplete or skewed interpretation of the data provenance and integrity.

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The challenges associated with managing and interpreting data from sophisticated, collaborative research efforts underscore the importance of a comprehensive and nuanced analysis by investigative bodies. A thorough investigation into these matters should encompass not only the data itself but also the mechanisms and practices employed by the collective of scientists responsible for its generation and stewardship. Failure to do so may result in misjudgments that overlook the complexities and collaborative nature of modern scientific research.

d. Anomalies Do Not Amount to Data Fabrication and/or Data Falsification.

The critique presented by Dr. Hamlin and subsequently endorsed by the Investigation Committee, positing that the observed similarities in the structures of the R(T) and χ(T) data necessarily indicate data fabrication, represents an overly simplistic and fundamentally flawed interpretation of the experimental outcomes. It is imperative to recognize that the use of analogous experimental apparatuses and configurations across different types of measurements, such as those pertaining to resistance or susceptibility, inherently predisposes the resultant data to exhibit comparable anomalies. This phenomenon is not indicative of any malfeasance but rather mirrors the intrinsic characteristics of the materials under investigation and the experimental framework employed.

Moreover, the presence of non-Gaussian noise within the data, a point of contention highlighted in the critique, is a relatively common occurrence within the domain of high-pressure physics research. Such critiques often overlook the broad spectrum of noise behaviors that can manifest in complex systems subjected to extreme experimental conditions. Further investigations conducted by our team, aimed at delineating the origins of this noise, have elucidated that these characteristics emerge from specific experimental parameters, rather than because of any deliberate data manipulation.

The committee's reliance on Dr. Hamlin's analysis as the cornerstone of their accusation of data fabrication is predicated on a misinterpretation of the experimental evidence. The assertion that anomalies identified in data collected at pressures of 267 GPa, when seen in conjunction with similar anomalies in susceptibility measurements, unequivocally suggest data fabrication, fails to consider the fundamental aspects of experimental physics. Whether the experiments measure susceptibility or resistance, the underlying principle involves the measurement of a voltage response, utilizing a consistent set of instruments such as lock-in amplifiers, AC current sources, and pre-amplifiers across these experimental setups. Consequently, the similar features observed across different datasets should be understood as a direct outcome of the shared experimental conditions and instrument settings, rather than as hallmarks of fabrication.

More specifically, subsequent analyses conducted by our team have elucidated that the behaviors observed in the data can be attributed to the specific characteristics of the digital filtering process, namely the Gaussian Finite Impulse Response (FIR) filter, in relation to the variance, delta(R), in resistance measurements from the mean. This finding indicates that the so-called "unusual" behavior, as identified by certain critiques, is in fact a result of the significant delta(R) in the context of the bandwidth limitations of the Model SR860 lock-in amplifier. This nuanced understanding emerged only through our dedicated efforts to investigate the underlying causes of the observed data characteristics. Consequently, the premature labeling of our research as

fraudulent by Hamlin and others, based on the presence of non-Gaussian noise and perceived irregularities, was a hasty conclusion drawn from a misunderstanding of the data's nature.

The reliance on such "unusual" data characteristics as evidence of fabrication by the Investigation Committee represents a flawed investigative approach. A comprehensive and methodical examination requires more than superficial observations of data anomalies to establish claims of data fabrication. It is concerning that the Committee's conclusions seem to be heavily influenced by the assessments provided by James Hamlin, without a deeper, independent analysis. The methodology adopted by the Committee could be seen as indicative of a bias towards confirming pre-existing hypotheses, an inclination to find patterns where none may exist (apophenia), and a propensity for selective skepticism—critiquing established accounts while uncritically accepting speculative assertions. The logical foundation for the accusation that the data has been fabricated is, from our perspective, non-existent. Such charges appear to be based on conjecture, the identification of supposed patterns, or the subjective characterization of data as "unusual," rather than on rigorously substantiated scientific evidence.

The approach taken by the Investigation Committee to substantiate claims of data fabrication or falsification lacks the scientific rigor expected of such investigative processes. The development of accusations seems to be predicated more on speculative reasoning and less on empirical evidence. It is vital for the integrity of scientific inquiry that conclusions are drawn from thorough and unbiased evaluations of all available data, rather than reliance on preliminary assumptions or external analyses that may not fully account for the complexity of the experimental conditions and data characteristics.

e. The Investigation Committee Ignores the Fact that the Data is Raw Data Measured.

The assertion by the committee that the absence of provided raw data equates to data fabrication necessitates a restatement and clarification from my end. It is imperative to underscore that the data shared and discussed is indeed the raw data collected during the experiments. My engagement with the field of superconductivity under high-pressure conditions has been a dedicated and passionate pursuit since 2008, beginning with my tenure in the esteemed research group led by Professor Choong-Shik Yoo. My initial research endeavors focused on the study of carbon and sulfur mixtures, notably starting with carbon disulfide (CS_2), and subsequently extending to hydrogen sulfide (H_2S) in 2009, a full six years ahead of the significant contributions by Eremets and his team. During this period, my experiments achieved pressures up to 110 GPa, revealing the decomposition of H_2S and the emergence of sulfur's superconductivity, suggesting that further exploration might have led to the early discovery of H_3S superconductivity.

The strategic decision to integrate carbon into the H_2S system, leading to the groundbreaking identification of carbonaceous sulfur hydride (CSH), was driven by insightful intuition and a deep understanding of the critical role played by a ternary system with covalent bonds in advancing our research goals. This innovative approach positioned our work at the forefront of the field, predating the broader acknowledgment of its significance.

In relation to the study of magnesium diboride (MgB_2), the realization emerged that the achievement of superconductivity at elevated temperatures necessitates the presence of strong

covalent bonding and antibonding states that intersect with the Fermi level. The scarcity of covalent metals under standard conditions presents a significant challenge. However, this obstacle is surmountable through the exploration of hydrogen-rich compounds, or hydrides, under high-pressure conditions, which are characterized by an abundance of hydrogen. These compounds, with their inherent impurities, serve as a form of chemical pressure that effectively lowers the threshold pressure required for the metallization process, thereby facilitating the conditions necessary for superconductivity.

f. The Investigation Committee Fails to Appreciate the Role of Carbon Doping to Superconductivity.

The consideration of electronegativity among non-hydrogen atoms plays a critical role in the synthesis of covalent metals, directly impacting the feasibility of achieving high critical temperature (Tc) superconductivity. Elements exhibiting strong electronegativity tendencies tend to form insulating hydrides, whereas those with lower electronegativity are more likely to result in hydrides possessing reduced Tc values. In this context, sulfur emerges as a particularly promising candidate for forming a covalent metal with hydrogen, given its slightly higher electronegativity compared to hydrogen, as detailed in the following table:

ELEMENTS	ELECTRONEGATIVITY
Hydrogen	2.2
Sulfur	2.58
Carbon	2.55
Oxygen	3.44
Nitrogen	3.04
Yttrium	1.22

Table.1 Electronegativity of selected lighter element.

The proximity in electronegativity values between carbon and sulfur intrigued me, prompting further exploration into carbon as a viable element for my research endeavors. Notably, hydrogen's light mass contributes to a high phonon frequency, approximately ~0.2 eV, a characteristic surprisingly shared by carbon systems. This observation, coupled with carbon's ability to form strong covalent bonds and its versatility in generating diverse compounds, underscored the potential limitations in enhancing Tc within binary systems, while simultaneously highlighting the expansive opportunities offered by ternary systems for further exploration.

Driven by the potential of carbon to establish robust covalent bonds and building upon my prior research into the superconductivity of dense carbon disulfide (CS2), my investigations naturally evolved towards the pursuit of high Tc superconductors within ternary compounds comprised of carbon, sulfur, and hydrogen. This line of inquiry led to the observation of superconductivity within this specific ternary system. The concept of carbonaceous sulfur hydride (CSH), along with the findings from these investigations, was initially presented during my Carnegie Fellowship interview in 2012, a detail corroborated by Dr. Viktor Struzhkin, a member of the Carnegie Fellowship committee present at the discussion. Furthermore, my faculty application to the

University of Rochester in 2017 made reference to CSH, attesting to the enduring nature of these research interests and achievements. Between 2016 and 2018, I engaged in comprehensive discussions regarding these ideas with theorists such as Chris Pickard, who undertook preliminary investigations into these systems, informed by the experimental results we had obtained.

g. Data Was Not Secreted from Anyone.

It is essential to emphasize that the data and results in question were always handled with complete transparency. From the very beginning of the university's inquiry process, I took proactive steps to ensure that all pertinent information was openly communicated to Research Dean John Tarduno. This commitment to openness extended to all authors and collaborators associated with the project, who were thoroughly briefed and kept fully informed at every stage.

Given this context, any suggestions of secrecy or the dissemination of misleading information are entirely unfounded. The integrity of the data sharing process was maintained rigorously, reflecting a steadfast dedication to the principles of transparency and accuracy. This approach was consistent and deliberate, aimed at fostering an environment where all stakeholders had unrestricted access to the relevant information, thereby precluding any basis for allegations of misinformation or concealment related to this work.

Indeed, the scope of this investigation should not encompass these results, as they lack relevance to the National Science Foundation (NSF) or the University of Rochester. The investigation should exclusively consider the data from the 2020 CSH paper, which was gathered at the University of Rochester by graduate students of the same institution and funded by the NSF and DOE. Maintaining a focused and pertinent scope is essential to uphold the integrity and efficiency of the investigative process.

h. My Collaboration with Prof. Ashkan Salamat was a Mistake but It Is Not Scientific Misconduct.

The decision to collaborate with Dr. Ashkan Salamat, in hindsight, may have been ill-advised; however, it does not constitute scientific misconduct. It is imperative that the Investigation Committee conducts a thorough review of Dr. Salamat's contributions, particularly in relation to the data points he provided for Figure 1b and certain critical temperature versus pressure (Tc vs P) data points. It should be noted that all resistance versus temperature (R vs T) data corresponding to these Tc vs P points, which were integral to our collaborative work, originated from my research efforts. I categorically deny any responsibility for inaccuracies or misrepresentations in the data points directly attributed to Dr. Salamat.

It has been my observation that Dr. Salamat's motivations in seeking acknowledgment and credit might stem from a desire to establish himself as a pivotal figure in the field of ambient condition superconductivity, independent of the contributions of others. Regrettably, this pursuit of recognition appears to have led to attempts to diminish my contributions, effectively turning our past collaboration into a point of contention against me.

This situation highlights a significant oversight by the Investigation Committee in failing to critically evaluate the potential bias and self-serving nature of Dr. Salamat's statements, which seem designed to undermine my professional standing while obscuring his own involvement and responsibility. A more balanced and comprehensive assessment of these dynamics is essential for a fair and accurate resolution of the issues at hand.

i. The Investigation Misapplies “Typical Behavior” To Misinterpret Experimental Results.

In addressing the concerns raised by the Investigation Committee regarding the purported absence of what they have deemed "typical cool-down behavior," it becomes necessary to critically examine their understanding of what constitutes "typical behavior" within the specific context of low-temperature experiments. With nearly 16 years of experience in this specialized field, I have observed firsthand how the definition of typical cooldown behavior is profoundly influenced by a myriad of experimental parameters. This experience suggests that the Committee's assessment may be limited by an incomplete comprehension of these complex experimental dynamics, or perhaps by an inclination to identify discrepancies that align with a predetermined narrative.

The Committee's conclusions seem to be hastily formed, lacking a deep engagement with the underlying principles and nuances of the data in question. Their suggestion that similarities between the susceptibility and resistivity data indicate fabrication is unfounded, revealing a gap in their understanding of statistical manipulation techniques, as previously demonstrated by the deeply flawed approach used by Drs. Hirsch or van der Marel. This lack of insight into the fundamental aspects of experimental outcomes raises concerns about the Committee's capacity to conduct thorough and nuanced analyses.

To further clarify these points, I am prepared to present detailed examples of cooling data that demonstrate the linear cooldown behavior under discussion. Such illustrations, as depicted in Figure 1, serve to underline the variability of "typical" experimental results and challenge the Committee's assertions by providing concrete evidence of the behaviors observed in our experiments. This approach aims to foster a more informed and accurate interpretation of the data, moving beyond superficial judgments to embrace the complexity and variability inherent in low-temperature experimental research.

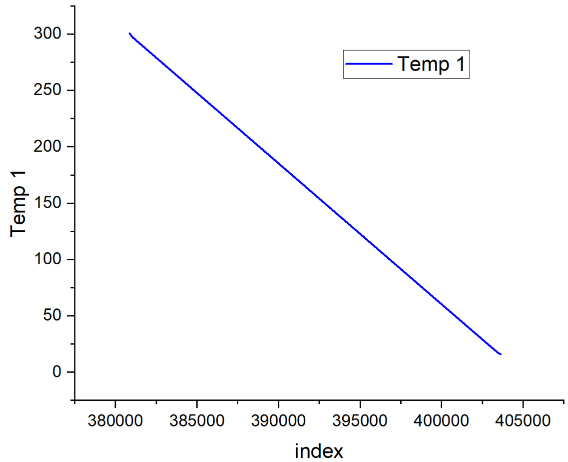


Figure 1. Contrary to the Investigation Committee's perspective, the plot above does not exhibit the purported "typical behavior" they have described. Rather, it portrays a straightforward linear pattern.

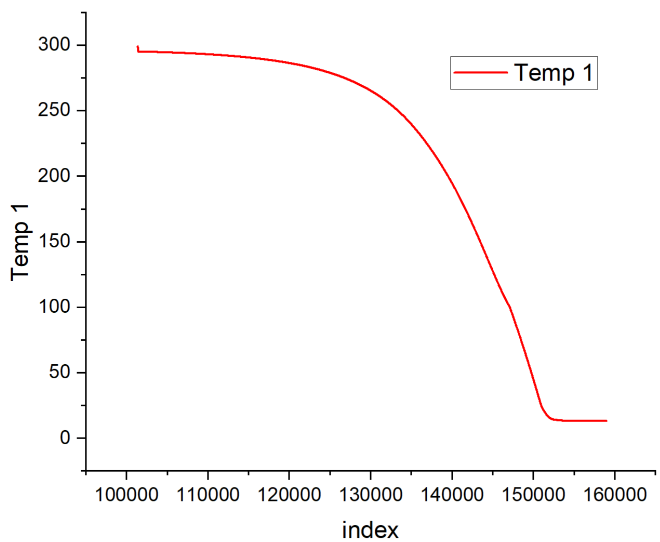


Figure 2. This plot does not depict the asserted "typical behavior" as described by the Investigation Committee.

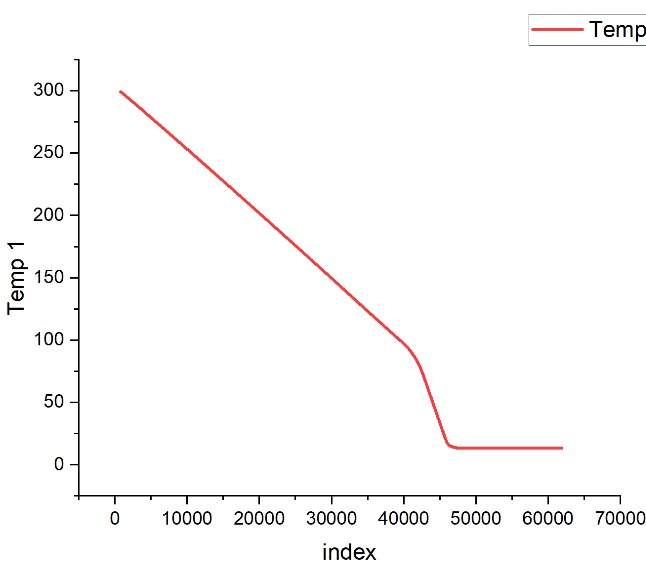


Figure 3. This plot does not depict the asserted "typical behavior" as described by the Investigation Committee.

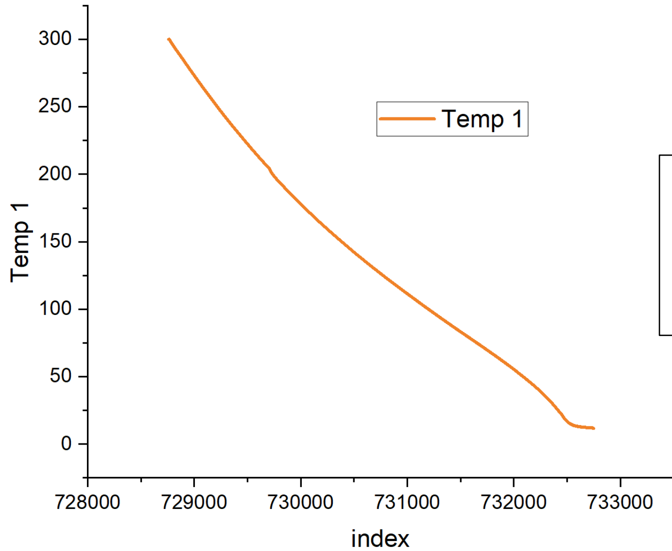


Figure 4. This plot does not depict the asserted "typical behavior" as described by the Investigation Committee.

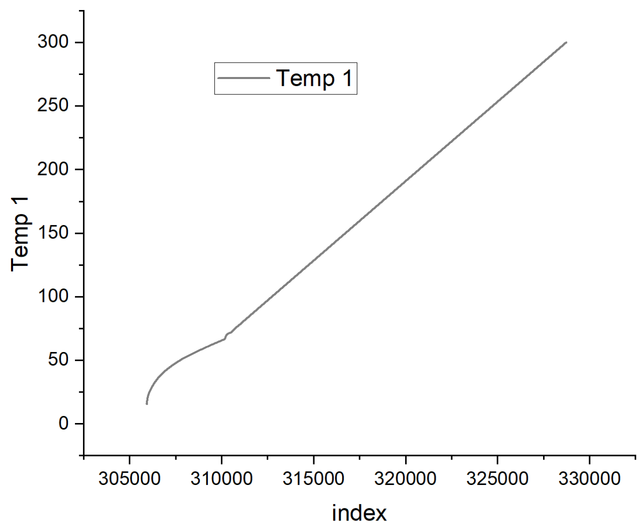


Fig. 5. A warming behavior of a given experiment.

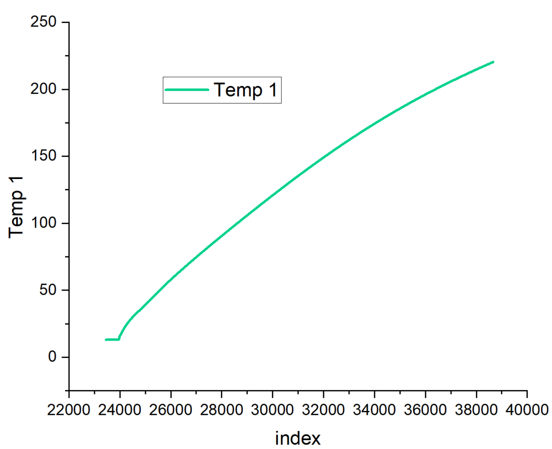


Fig. 6. A warming behavior of another experiment.

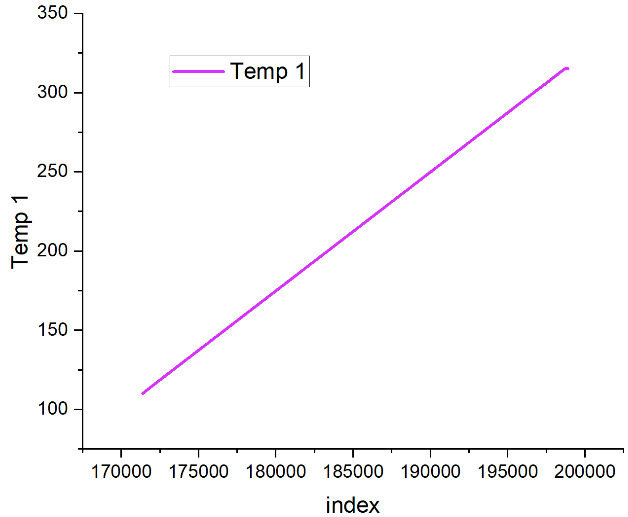


Fig. 7. A warming behavior of another experiment.

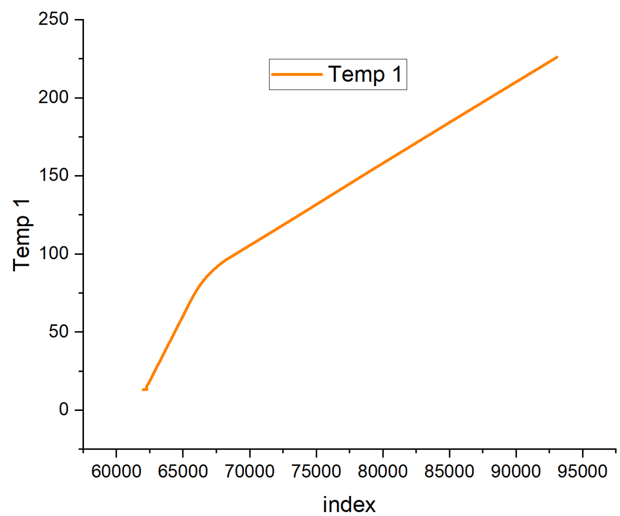


Fig. 8. A warming behavior of another experiment.

j. Conclusion.

In summary, I firmly address the allegations of data fabrication and falsification brought forth by the Investigation Committee regarding our Nature 2020 publication, underscoring that these claims are baseless and unsupported by concrete evidence. My response is grounded in a commitment to scientific integrity and transparency, which has characterized my entire career.

Firstly, the Committee's reliance on external claims, notably those by James Hamlin, without an independent and critical analysis, undermines the essence of an impartial investigation. It's crucial that an investigative body conducts its evaluations based on direct evidence rather than echoing external opinions, a principle that seems to have been overlooked in this case.

I also wish to clarify that comprehensive raw data was fully accessible to the Committee. Throughout my professional journey, I've upheld the highest standards of data sharing, making all

relevant information readily available for review. Misinterpretations regarding the provision of raw data and the scientific process of transitioning data into publication-ready figures have led to unfounded accusations.

Moreover, the collaborative nature of this research, involving multiple researchers and sites, seems to have been misunderstood, leading to misconceptions about data consistency and origins. High-pressure physics research is inherently complex, and any discrepancies likely stem from miscommunication rather than any intent to mislead.

The Committee's interpretation of anomalies within the data also misses the mark. Such characteristics are common in high-pressure research and are a result of the experimental setup and conditions, not indicators of data manipulation. My work has always been driven by curiosity and a pursuit of knowledge, especially in the realm of superconductivity under high-pressure conditions, including the exploration of carbonaceous sulfur hydride (CSH) and the significance of electronegativity in forming covalent metals.

I have always fostered an environment of transparency and open discourse, contrary to the allegations of data being withheld. Every collaborator and institutional representative was fully briefed, ensuring a collective understanding of the research process and findings.

Reflecting on the collaboration with Dr. Ashkan Salamat, it's important to distinguish between personal disagreements and scientific conduct. The integrity of our scientific contributions should not be overshadowed by collaborative dynamics.

Lastly, the Committee's stance on "typical cool-down behavior" reflects a misunderstanding of experimental variability. My extensive experience in low-temperature experiments demonstrates that what is considered "typical" can vary widely, depending on numerous factors inherent to such research.

Based on the foregoing, I advocate for a reevaluation of the allegations against me, emphasizing the need for a more nuanced, evidence-based approach by the Investigation Committee. My responses, rooted in a deep commitment to the principles of scientific research, aim to clarify the misunderstandings that have led to these unfounded accusations. It is my hope that a closer examination of the evidence will affirm the integrity of our work and the innovative contributions we've made to the field.

5. There Was No Intention to Plagiarize Any Aspect of Version 2 of the 2021 arXiv Article, Responding to Criticism of the Nature 2020 (CSH) Paper.

In this response to the allegations presented by the Investigation Committee, I address the non-specific accusation of plagiarism allegedly concerning one sentence in Version 2 of our 2021 arXiv article, responding to criticism of the Nature 2020 (CSH) Paper. The claim that one sentence bears undue similarity to content from James Hamlin's thesis is the latest in what I perceive as a series of attempts to find fault with my scholarly work. I note that the Investigation Committee has not identified the alleged single sentence with any degree of specificity in its draft report. Instead, the Investigation Committee writes that it "found at least one sentence in Respondent's 2021 arXiv

article that appeared in Dr. Hamlin's PhD dissertation but not in Respondent's PhD dissertation." I have a vague recollection that during a zoom interview, the Committee Chair referenced the potential single sentence that is apparently referred to in the draft report.

This accusation, focusing on a mere fragment of our extensive research, overlooks the essence of academic endeavor and the nuances of scientific discourse. I am compelled to assert that there was no intention to plagiarize at any point during the drafting or publication of our article.

The relentless pursuit of this and similar allegations by the Investigation Committee seems to reflect a broader narrative—a narrative that appears less concerned with uncovering factual inconsistencies and more with sustaining a predetermined outcome. This approach, I argue, stands in stark contrast to the principles of fairness, impartiality, and due process that are fundamental to the integrity of any investigative process.

To the extent that the undisclosed sentence in question was part of a collaborative effort to outline a standard method widely accepted within our research community. This method, serving as essential background information, represents a well-trodden path in scientific inquiry where the expression of established knowledge is inherently limited by the precision required in scientific communication. Furthermore, the collaborative nature of our work, particularly the significant contributions from my colleague Ashkan Salamat, complicates the attribution of individual sentences and further challenges the accusation of intentional plagiarism.

Finally, by examining the publication practices of the Investigation Committee Chair, I aim to highlight the inconsistencies in applying standards of originality and plagiarism. Through this examination, I intend to question the fairness and objectivity of the investigative process, thereby challenging the basis of the plagiarism accusation itself.

a. The Alleged Unidentified Single Sentence Likely Discussing Methods and/or Background Information Does Not Constitute Intentional Plagiarism.

The arXiv note we submitted merely outlines a standard method widely accepted within the high-pressure superconductivity community. It serves as background information and presents a well-established procedure. When dealing with such scientific methods and background information, there exists a finite set of ways to express it effectively and branding it as plagiarism is unwarranted. The arXiv note in question was a collaborative effort between myself and Ashkan Salamat, with a substantial contribution from Ashkan Salamat for writing. The specific authorship of this particular section remains indeterminate. Without identification of the specific alleged single sentence and clear authorship attribution, it is perplexing how the Investigation Committee is unequivocally pointing fingers in my direction. This strongly suggests a preconceived and premeditated agenda to pin blame on me. Also, I do not understand the intentional plagiarism here.

b. There Are Only So Many Ways to Describe Common Methods and Background Information in Scientific Writing.

In the domain of scientific inquiry, particularly within the field of superconductivity research, the drafting of the Methods and Background sections of a research paper represents a formidable

challenge. This challenge is rooted in the very nature of scientific exploration—a discipline that is fundamentally incremental and built upon the cumulative knowledge of previous work. The essence of our endeavor is not to reinvent the wheel with each study, but rather to expand, refine, and sometimes challenge the established body of knowledge. As such, the articulation of widely accepted methods and foundational theories is constrained by the necessity for precision and uniformity in scientific communication. This constraint is further compounded for researchers for whom English is not the first language, introducing an additional layer of complexity to the task of scientific writing.

There are a number of challenges in scientific writing. Some of the key challenges include:

- Building on Existing Knowledge: The progression of scientific research is predicated on the expansion of existing theories and methodologies. This approach inherently limits the novelty of the language that can be used to describe established methods and background information, as researchers must align with the canonical understanding and expression of these concepts.

- Limited Lexical Flexibility: The precision required in the scientific discourse means that the terminology and definitions used to describe established principles and methods are often fixed. This limitation restricts the ability of researchers to rephrase or reinterpret these concepts without risking the loss of accuracy or inadvertently mirroring the language used in prior works. Such constraints pose a significant challenge in maintaining originality while ensuring the integrity of the conveyed information.

- The Imperative of Clarity and Originality: Navigating the fine line between clarity in the presentation of established knowledge and the introduction of novel insights is a critical aspect of scientific writing. Researchers must endeavor to clearly delineate their unique contributions against the backdrop of the existing literature, a task that demands both meticulous attention to detail and an overarching understanding of the field's current state.

The composition of the Methods and Background sections, therefore, is not merely a matter of rote documentation but a nuanced exercise in articulating the continuity and advancements within the field. The challenge of avoiding unintentional plagiarism in this context is significant, underlining the importance of rigorous citation practices and the ethical imperative to distinguish clearly between the established canon and one's contributions. The objective is to contribute meaningfully to the dialogue within the scientific community, advancing understanding while respecting the foundational work that makes such advancements possible.

In navigating the complex and intricate landscape of scientific research, particularly in the preparation of our Version 2 of the 2021 arXiv article, responding to criticism of the Nature 2020 (CSH) Paper, my colleagues and I have striven to uphold the highest standards of academic integrity and scholarly contribution. Throughout this process, our guiding principle has been to advance understanding within our field while meticulously acknowledging the foundational work upon which we build. It is with a clear conscience and firm conviction that I assert there was absolutely no intention to plagiarize any aspect of James Hamlin's PhD dissertation, or indeed any other work, in our publication. Our commitment to the principles of originality, transparency, and

ethical scholarship has been unwavering, and it deeply concerns me that our intentions could be misconstrued. The essence of our endeavor has always been to contribute meaningfully and respectfully to the ongoing dialogue in our field, not to detract from it through the misappropriation of ideas or words.

c. Conclusion.

In addressing the allegations of intentional plagiarism in relation to one sentence in Version 2 of our 2021 arXiv article, which responded to criticism of the Nature 2020 (CSH) Paper, I firmly deny any such intention. The Investigation Committee's focus on a single, unspecified sentence and its purported similarity to content in James Hamlin's PhD dissertation overlooks the collaborative and cumulative nature of scientific research and writing.

The assertion of plagiarism does not consider the context within which scientific discourse operates—particularly the description of methods and background information. Such content, by necessity, draws on a common pool of knowledge and language that is widely recognized and accepted within the scientific community. The method in question represents standard practice in the field of high-pressure superconductivity, making it challenging to articulate without referencing established terminologies and procedures.

This contention also fails to acknowledge the collaborative effort behind the drafting of the arXiv note, significantly contributed to by my colleague, Ashkan Salamat. The collaborative nature of this work, coupled with the specific focus on widely accepted methodologies, underscores the complexity of attributing plagiarism to any individual, especially when the sentence in question has not been explicitly identified by the Committee.

Moreover, the constraints of scientific writing, particularly in fields that build upon existing knowledge and methodologies, inherently limit the variety of expressions one can use without compromising the accuracy or clarity of the scientific message. This limitation is even more pronounced for researchers who operate in a second language, where the challenge of articulating complex scientific ideas in English adds an additional layer of difficulty.

Our endeavor has always been to contribute constructively to the scientific dialogue, adhering to the highest standards of academic integrity. The allegations of plagiarism, based on a misunderstanding of the nature of scientific writing and the specific challenges it entails, are unfounded and detract from the actual contributions of our work.

It is with a clear commitment to the ethical conduct of research and scholarship that I reject the notion of any intentional plagiarism in our work. Our primary objective remains the advancement of knowledge within our field, built upon a foundation of respect for previous work and a dedication to contributing new insights and understanding.

2. Figure 1c, Tc(P) Data (Superconducting Critical Temperature as a Function of Pressure) Was Not Fabricated nor Falsified.

My response herein collectively addresses all the claims wrongly made by the Investigation Committee as all the claims relate to the same unsupported and unfounded accusation i.e. that I fabricated and falsified the Tc vs P data. It is imperative to highlight the Investigation Committee had unfettered access to and obtained complete copies of all my computers, files, and records. Consequently, every piece of data collected in my lab was fully available for their scrutiny. The Investigation Committee, equipped with extensive resources, held meetings with students, research faculty, collaborators, and accessed information from editors, enjoying unrestricted access to all lab data. The assertion that I withheld data is unfounded, constituting a gross misrepresentation of the factual situation.

a. The Correct Definition of a “Run” in High-Pressure, Low-Temperature Superconductivity Experiments.

In the specialized field of high-pressure, low-temperature superconductivity, a "run" typically refers to a single iteration or execution of an experiment under a defined set of conditions. This term is used to denote the process of conducting the experiment from start to finish, encompassing the preparation, the actual experimental procedure, and the subsequent analysis of results. Each run is designed to test specific variables or conditions, such as pressure, temperature, magnetic fields, or material composition, to observe their effects on the material's ability to exhibit superconductivity.

In high-pressure, low-temperature superconductivity experiments, controlling and accurately measuring these conditions are critical, as the superconducting properties of materials can be highly sensitive to changes in environmental parameters. A "run" may involve the application of high pressure and cooling the material to low temperatures to determine at which pressure and temperature the material transitions to a superconducting state.

Multiple runs may be conducted to systematically explore a range of conditions, to replicate findings for verification, or to investigate different materials. Each run provides valuable data that contribute to understanding the behavior of superconductors under various conditions, aiding in the development of theories and practical applications of superconductivity.

b. The Investigation Committee’s Definition of a “Run” is Not Complete.

The Investigation Committee's definition of a "run" as representing the same sample under varying pressures might not be accurately capturing the complexity and nuance of conducting experiments in the field of high-pressure, low-temperature superconductivity. This definition appears too restrictive and may overlook several critical aspects of experimental design and data interpretation in this specialized domain for the following reasons:

Multifaceted Nature of Experimental Variables: In high-pressure, low-temperature superconductivity research, the outcome of an experiment can be influenced by a multitude of variables beyond just pressure. Temperature, magnetic field, chemical composition, and structural

properties of the sample are also crucial. A comprehensive definition of a "run" should account for the interplay between these variables and not limit the understanding to pressure variations alone.

Reproducibility and Verification: Scientific experiments often require the reproducibility of results under identical conditions to verify findings. If a "run" is defined solely by changing pressure levels on the same sample, this might neglect the importance of repeating experiments with new samples under the same conditions to confirm the results' consistency and reliability.

Experimental Scope and Objectives: The scope of high-pressure, low-temperature superconductivity research often extends beyond observing the effects of pressure changes. Experiments may aim to understand the role of the structures, interactions, or the effects of doping on superconductivity. A more inclusive definition of a "run" should reflect the experiment's broader objectives, accommodating various investigative focuses beyond pressure variations.

Data Analysis and Interpretation: Analyzing data from experiments that only vary pressure on the same sample might lead to incomplete or skewed interpretations of superconductivity phenomena if the starting composition is different. A holistic approach, considering runs as comprehensive sets of conditions, would provide a more robust framework for analyzing how different variables collectively influence superconductivity.

In light of these considerations, it is advisable for the Investigation Committee to adopt a more nuanced definition of a "run" that encompasses the full spectrum of experimental conditions and acknowledges the complex dynamics at play in high-pressure, low-temperature superconductivity research. This approach would ensure a more accurate and comprehensive understanding of our experimental results and their implications for the field.

c. CSH is Extremely Sensitive to Its Carbon Content Composition.

I have repeatedly emphasized the critical sensitivity of Carbonaceous Sulfur Hydride (CSH) samples to their carbon content, stressing the necessity for comparisons to be made between samples with equivalent compositions. Any deviation from this standard results in fundamentally flawed comparisons. This sensitivity to composition is a crucial aspect that seems to be underestimated by those not directly involved in conducting these experiments. Despite the Investigation Committee's suggestions, which appear to claim a deeper insight than those of us engaged in the actual research, we have transparently communicated the paramount importance of carbon content in determining the superconductivity of CSH. Consistently achieving uniform composition in our samples has been a significant challenge, highlighting the intricacy and detailed nature of our work.

The lack of precisely matched compositions leads to variations in the pressure-dependent superconducting transition temperature (Tc) values, potentially obscuring the true relationship between Tc and pressure within CSH samples. This makes it difficult to ascertain clear conclusions. However, the Investigation Committee's methodology, which simplifies comparisons to 'Runs' of the same sample under varying pressures, neglects the essential complexities of our experiments. Their reliance on observing similarities in resistance values across different runs overlooks the critical details of our measurements.

Our research focuses on measuring the four-probe resistance of highly inhomogeneous CSH samples, where variations in size can significantly affect the outcomes. It is essential to clarify that our measurements were resistance, which is affected by the physical dimensions of the sample, rather than resistivity. Therefore, resistance values can exhibit a wide range of variability. Although these values generally decrease under pressure, to suggest similarity or difference without considering these intricacies oversimplifies the situation.

Having devoted myself to this research field since 2009, the Investigation Committee's premature conclusions, based on just a few months of cursory review, seem to reflect a predetermined bias rather than an earnest pursuit of truth. The complexity of our research and the critical role of carbon content in our CSH samples warrant a more nuanced and informed examination than what has been provided, underscoring the importance of engaging deeply with the subtleties of high-pressure, low-temperature superconductivity research.

d. CSH Synthesis and the Importance of Compositional Tuning.

Upon thorough examination of the draft report, I must express my concerns regarding the unfounded allegations of misconduct. The committee's accusations of data falsification and fabrication are not substantiated by concrete evidence and appear to stem from speculative reasoning. In our detailed disclosures on the arXiv platform, we have meticulously outlined our synthesis process, explicitly acknowledging the inherent challenges in attaining uniform composition. The variability observed in sample composition is not a result of neglect but a fundamental characteristic of the experimental methodology, a fact that has been transparently communicated. The oversight by the committee to recognize this essential aspect casts doubts on the accuracy and reliability of their evaluation. Our arXiv posts clearly articulate the synthesis procedure and underscore the significance of compositional tuning in our research. We have publicly disclosed the CSH Synthesis Procedure as follows:

<u>C-S-H Synthesis Procedure</u>

Diamond anvil cell (DAC) Preparation

- Load Carbon and Sulfur (C:S) mixture and Ruby (Al_2O_3: Cr) for pressure marker to a completed resistivity setup in a DAC
    - We used ball milled 1:1 C:S mixture, but attempt to load a cluster that appears equal in carbon and sulfur content
    - Ruby is needed to monitor the pressure. Keep the amount as small as possible
    - Load Hydrogen via gas loading (3000 bar) or cryogenic.

Photochemical Procedure

- Press sample (CS + H_2) to 3.75-4.0 GPa
    - We have created crystals anywhere in this pressure range

- Using 532nm laser, 20-25mW, heat CS sample for 30 minutes

- If you see "waves" in the hydrogen around the CS, you are in a good pressure range
- If there is ample H_2 and CS in the correct pressure range, crystals will begin to form and initially look like bubbles
- After initial "bubble" is formed, continue heating with same power for 5-10 minute sessions on different parts of the sample
- Once the crystal stops growing in size/no more new crystals, press the sample to 4.2-4.5 GPa

- At 4.5 GPa the crystal will become less volatile, but still affected by the laser
  - While monitoring the sample lower laser power to ~5 mW and run the laser spot around the sample. You will see movement in the sample and rapid crystal growth throughout the sample chamber
  - Once you are happy with the size and placement of the crystal, press to 8 to 10 GPa to increase the stability of the crystal

e. The Investigation Committee Ignores Our Comprehensive Presentation of Raman Spectra.

Furthermore, we have included a comprehensive presentation of Raman spectra derived from various compositions within our study. This selection showcases the diverse outcomes resulting from the specific compositional differences of the samples. The significance of employing particular compositions is critically analyzed, demonstrating their impact on the observed Raman spectral characteristics. Figure 1 serves as a visual reference, illustrating the correlation between composition and the resultant Raman spectra.

This detailed inclusion underscores the meticulous approach adopted in our research to discern the subtle yet profound effects of composition on the material's properties. By systematically comparing the Raman spectra across a spectrum of compositions, we aim to elucidate the underlying mechanisms that govern the material's behavior under different conditions. This analysis not only enriches our understanding of the material's characteristics but also reinforces the importance of precision in compositional selection for the integrity of the study. Figure 1, therefore, is not merely an exhibit of data but a testament to the intricate relationship between composition and material response, serving as a cornerstone for the conclusions drawn in our research.

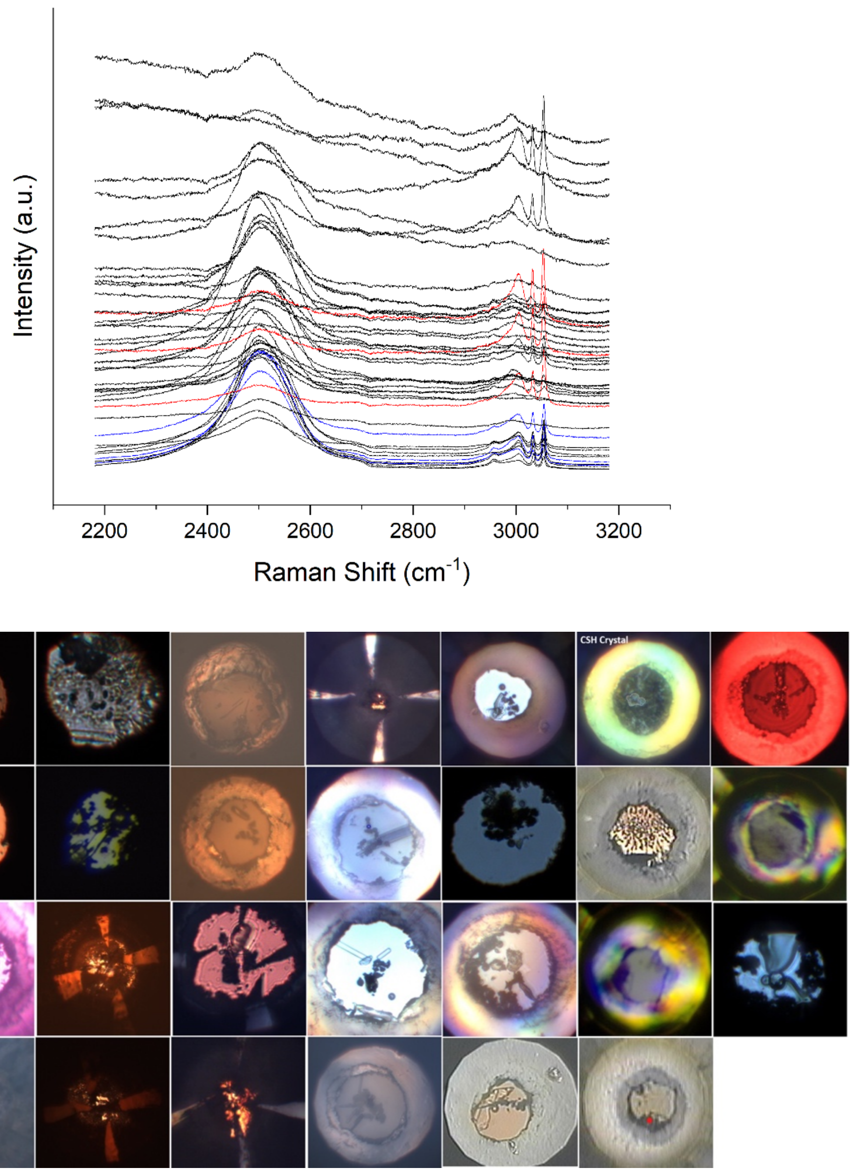


*Figure. 1. **(Top)** Raman spectra of different CSH crystals. **(Bottom)** A collection of micrographs taken under the microscope of CSH crystals in different diamond anvil cell loadings. The images are from both respective labs.*

f. All Data Points Are Available to the Investigation Committee.

The Investigation Committee, in its examination of our Lu-H-N paper, specifically aimed its criticism at Figure 1a, which illustrates the relationship between critical temperature (Tc) and pressure (P). They accused me of not offering any tangible evidence for the existence of 12 additional resistance versus temperature (R(T)) datasets, which were supposedly the basis of the data points in question. The committee prematurely deemed that 12 of the 17 data points on the Tc vs P plot were fictitious, a claim they made without anchoring it in any scientific evidence. In my defense, I provided irrefutable proof that each data point was derived from accurate resistance versus temperature (R vs T) measurements, thereby countering their baseless assertion.

It's crucial to emphasize the lack of direct engagement from the committee's side. At no point did they seek a personal discussion or clarification from me regarding their concerns, choosing instead to levy accusations without a thorough investigation or scientific justification. This approach not only demonstrates a lack of due diligence but also exposes the committee's predisposition and bias against me. My detailed response to their allegations, outlined in the "Response to Draft Report" dated January 29, 2024, meticulously addresses and refutes each point they raised, particularly in the Lu-H-N section, providing all necessary data plots and explanations.

Furthermore, the concept of carbonaceous sulfur hydride (CSH) and the associated findings were first introduced during my interview for the Carnegie Fellowship in 2012, a detail confirmed by Dr. Viktor Struzhkin, a committee member of the Carnegie Fellowship present at the interview. Additionally, my application for a faculty position at the University of Rochester in 2017 referenced CSH, demonstrating the long-standing nature of my research interests and accomplishments. Between 2016 and 2018, I engaged in extensive discussions about these ideas with theorists, including Chris Pickard, who conducted preliminary investigations into these systems based on the experimental results we had achieved.

The allegation by the committee regarding my failure to provide data is entirely without merit. It is crucial to note that the committee was granted unrestricted access to all my research materials, encompassing every file and data record from my computers and laboratory related to the NSF and DOE funded research. They undertook thorough investigations, which included dialogues with students, faculty, research collaborators, and journal editors, thereby having the chance to thoroughly review all dimensions of my work without limitations. Nevertheless, the committee's claim suggests either a neglect of details or, more concerning, an intentional misreading of the facts, indicating a profound bias on their part.

The allegation of data withholding is not only baseless but also a serious mischaracterization of the reality. All data relevant to the contested plot and beyond were fully disclosed to the committee. Their claims, mirroring the unfounded accusations regarding the Lu-H-N paper, lack scientific substantiation and appear to distort the truth. This pattern of behavior from the committee not only undermines the integrity of the investigative process but also highlights a clear bias against me, casting doubt on the legitimacy of their conclusions and the fairness of their methods.

g. Dr. Ashkan Salamat’s and UNLV’s Role in Data Collection.

Regarding Dr. Ashkan Salamat's and UNLV's role in data collection, it is imperative for the Investigation Committee to undertake a rigorous examination of the interview with Dr. Salamat, particularly in light of potential biases stemming from his termination as CEO of Unearthly Materials, Inc. It is essential for the committee to critically assess the information provided by Dr. Salamat and to verify both his credibility and the authenticity of the data in question.

In assessing the credibility of Dr. Salamat's contributions, it is noteworthy to highlight certain contextual elements. Specifically, efforts were made to enhance the reliability of the data through direct engagement with Dr. Salamat's laboratory. This involved a visit to Dr. Salamat's lab in the summer of 2018 to provide training to his students in conducting electrical conductivity measurements and low-temperature setups. Subsequently, in September 2019, Dr. Salamat facilitated a visit by his students to the University of Rochester for further measurements, aimed at corroborating the reliability of the data collected. Notably, these experiments were conducted using LN2 cryostats, colloquially referred to as "baby cryostats," capable of achieving temperatures of 100 to 150 K, which are suitable for the intended experiments.

As per Dr. Salamat, his team diligently persisted in their experimental endeavors throughout and beyond the pandemic period, a matter extensively deliberated upon during advisory sessions with Prof. Isaac Silvera. It is noteworthy that the data points depicted in Figure 1c, excluding those obtained from autonomous measurements, were extracted from presentations delivered by Dr. Salamat. Additionally, due consideration should be given to the fact that Dr. Ashkan Salamat is officially recognized as an inventor on the patent application pertaining to CSH research. It is imperative to underscore that the designation of inventor necessitates substantial contributions to the endeavor.

Given the circumstances surrounding Dr. Salamat's involvement and the potential implications of his termination from Unearthly Materials, Inc., the committee must conduct a thorough investigation into this matter. This investigation should involve a comprehensive examination of Dr. Salamat's statements and the data provided, ensuring the integrity of the information upon which any conclusions are based.

h. Conclusion

In conclusion, the investigation conducted by the Investigation Committee has failed to substantiate the allegations of data fabrication and falsification pertaining to the Tc vs P data presented in the Nature 2020 (CSH) paper. Despite unfounded claims and a lack of concrete evidence, the Investigation Committee has persisted in its accusations, seemingly influenced by a biased perspective. The Investigation Committee's oversight in comprehending the nuanced definition of a "run" in high-pressure, low-temperature superconductivity experiments further underscores their limited understanding of the complexities involved in our research.

Moreover, the Investigation Committee's disregard for the critical sensitivity of Carbonaceous Sulfur Hydride (CSH) samples to their carbon content composition and their oversight of the comprehensive presentation of Raman spectra further demonstrates their failure to engage deeply with the intricacies of our work. The absence of direct engagement with me and the unfounded

allegations of data withholding highlight the Investigation Committee's predisposition and lack of due diligence in their investigation.

Additionally, the Investigation Committee's handling of Dr. Ashkan Salamat's and UNLV's role in data collection raises concerns regarding potential biases stemming from Dr. Salamat's termination as CEO of Unearthly Materials, Inc. A thorough examination of Dr. Salamat's statements and the data provided is warranted to ensure the integrity of the information upon which any conclusions are based.

Overall, the Investigation Committee's investigation lacks scientific rigor, impartiality, and a comprehensive understanding of the intricacies of high-pressure, low-temperature superconductivity research. It is imperative that future inquiries into this matter prioritize objective analysis, thorough examination of evidence, and adherence to scientific principles to uphold the integrity of the research community and safeguard against unwarranted biases and misrepresentations.

D. Draft Report B. PRL 2021 (MnS2) Paper

1. The MnS_2 Data Provided to the Investigation Committee Does Correspond to Published Data Although it was Distorted by Adobe Illustrator Used by Prof. Ashkan Salamat.

The matter under discussion pertains to the discrepancies observed between the data (Figure 1b) published in the PRL 2021 paper on MnS2 and the dataset submitted to the Investigation Committee, as well as the dataset provided to PRL's post-publication referees. Our communication with PRL has already addressed these discrepancies; however, it appears that the Investigation Committee has overlooked our explanations, possibly due to a predetermined bias.

a. The Investigation Committee Ignores Convincing Evidence

Further to our previous communications with the PRL editors, we intend to adopt a different approach to elucidate the illogical and prejudiced nature of the committee's conclusions. It is critical to highlight that the Investigation Committee's evaluative methodology casts doubt on the integrity of their investigative process.

In preparing the final figure for publication (referenced as Figure 1), the UNLV team utilized Adobe Illustrator. Although the use of Adobe Illustrator altered the appearance of the actual data plots, the overall shape remained consistent. It is essential to note that Figure 1, as submitted and subsequently published in the PRL paper, was produced using Adobe Illustrator based on the original data available before publication and was the same dataset shared with both the committee and PRL post-publication. This clarifies that the data discrepancies noted by the committee stem from the graphical adjustments made during the figure's preparation and not from any discrepancies in the data itself.

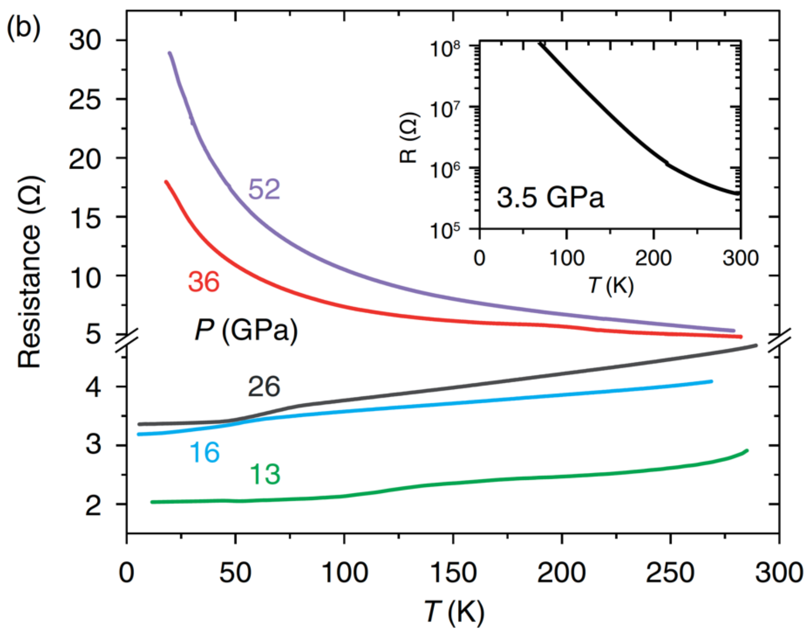
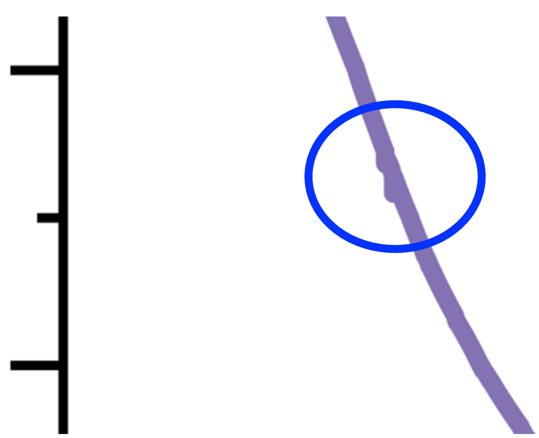


Figure 1. The final figure submitted to PRL and subsequently published.

In the draft report provided by the Investigation Committee, a crucial distinction was made regarding the validity of the data associated with different pressure measurements. The Investigation Committee explicitly stated that the data corresponding to pressures of 13, 16, and 26 GPa were fabricated, while affirming the integrity of the remaining datasets. This assertion implies an implicit bias, suggesting that the data's validity was influenced by the identity of the researcher collecting it. Notably, the Investigation Committee recognized the data for pressures of 36, 52, and 3.5 GPa as valid and reliable, underscoring the credibility of these measurements without reservation.

I direct the readers' attention to the 52 GPa data, represented in purple in Figure 1. The Investigation Committee's endorsement of this data as legitimate invites a closer examination, particularly in the vicinity of 30 K. Observations reveal a discernible distortion within this region, highlighted by a blue circle in Figure 2.

Figure 2. A detailed close-up of Figure 1 focusing on the region around 30 K, highlighting a noticeable decrease in resistance, as indicated by the blue circle.



To facilitate a clearer understanding, a comparison with Figure 3, which displays a zoomed-in view of the raw data around 30 K, is warranted. Here, a noticeable fluctuation in resistance is evident, with intervals of approximately 0.75 K.

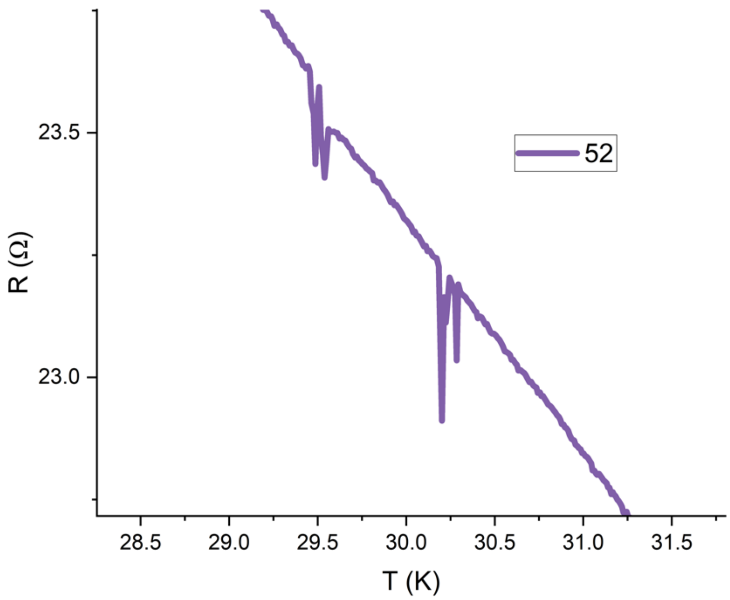


Figure 3. A magnified view of the raw data plot, concentrating on the same region as illustrated in Figure 2.

This comparison raises a pivotal question: Are the datasets depicted in Figures 2 and 3 identical? The answer is unequivocally negative, as a stark contrast is visible between the two presentations. The only variable distinguishing these figures is the software employed for their creation: Figure 2 was adjusted using Adobe Illustrator, while Figure 3 was generated directly from raw data using scientific software (Origin Pro).

Such discrepancies underscore the impact of Adobe Illustrator on the data's portrayal, challenging the committee's initial appraisal. Since the Investigation Committee validated the 52 GPa data, this observation suggests that any distortion observed must be attributed to the use of graphic software rather than to the data's authenticity.

An additional instance utilizing the same 52 GPa dataset further substantiates this argument. Analogous to the discrepancies observed around 30 K, there is a marked variance between the two depictions of the data, which can be exclusively ascribed to the different software applications employed in their generation. See Figure 4 below. This observation challenges the Investigative Committee's assertion of a disparity between the supplied raw data and the data as published, thereby validating the uniformity and dependability of the dataset upon detailed examination. Consequently, this undermines the Investigation Committee's evaluation that the raw data did not align with the published results.

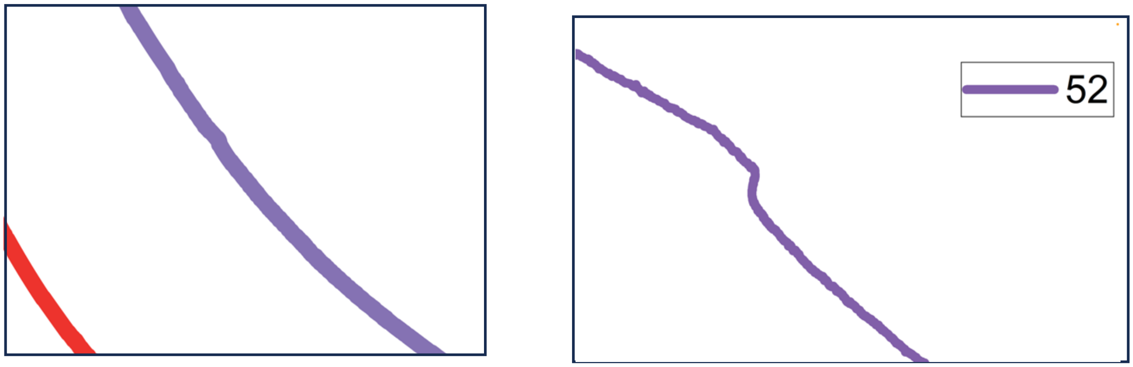


Figure 4. The zoomed in version of published figure (left) and raw data plot (right) focused on same region around 47 K.

An essential aspect to consider when employing Adobe Illustrator is its impact on data representation, especially in instances of sudden data fluctuations. For illustration, let's examine the inset of Figure 1b, both submitted to and published in Physical Review Letters (PRL).

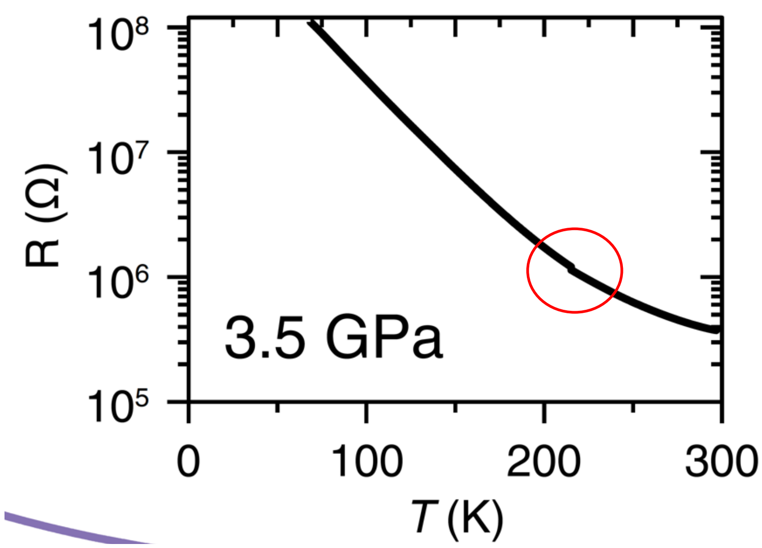


Figure 5. The inset of the Figure 1b submitted to PRL and subsequently published.

Notably, around 220 K (See red circle), there is a pronounced jump in the data, as observed in the figure we submitted to PRL, which was also included in the publication. Comparing this with the raw data plot (Figure 6) reveals no discrepancies; the anomaly appears identically in both the published figure and the raw data plot. The primary distinction lies in the creation tools: Figure 5, the inset of the published figure, was generated using Adobe Illustrator, while I created the raw data visualization in Origin Pro.

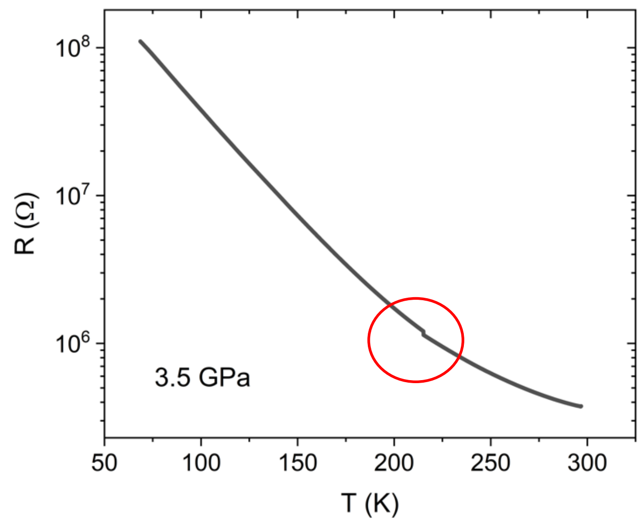


Figure 6. Same plot (inset in Fig 1b) using Origin Pro.

Additionally, the Investigation Committee identified a supposed abrupt jump at approximately 47 K in the MnS_2 data, drawing parallels to findings in GeSe4. However, a detailed review of the MnS_2 data reveals no such sudden shift. This critique seems to rely heavily on James Hamlin's methodology for data interpretation, which the Investigation Committee simply and blindly adopted without independent verification of the data's integrity.

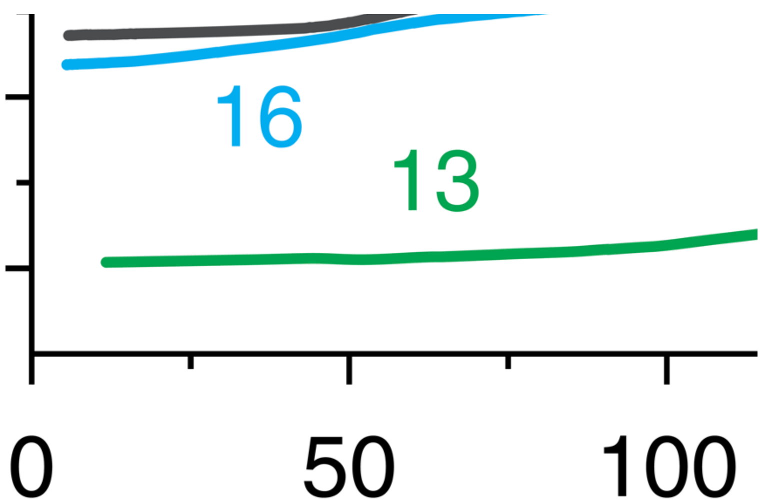


Figure 7. A detailed close-up of Figure 1a, created with Adobe Illustrator and later published, showing that there is no sudden increase in data around 50K.

If there were any significant discrepancies in the original plot, these would persist through the processing in Adobe Illustrator, as demonstrated in the inset of Figure 1b. As you can see in Figure 8 GeSe4 data there is a discontinuity in data around 50 K but no such a discontinuity around that temperature in MnS2 data as you can see in figure 7. This challenges the Investigation Committee's

finding of a similar discrepancy in both GeSe4 and MnS_2 data and unequivocally rules out any question about the alignment between the provided raw data and the published figures.

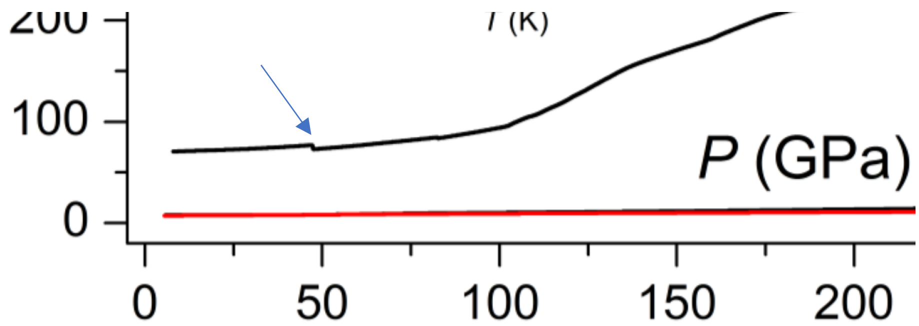


Figure 8. GeSe4 data at 13 GPa (black line) There is clear discontinuity in resistance around ~ 50 K. see blue arow.

In summary, the data figure submitted to PRL and included in the final publication (Figure 1) exhibits a high degree of fidelity to the raw data, with minor variations attributable to the use of Adobe Illustrator. The final figures produced by the UNLV group were generated using Adobe Illustrator, based on the data I provided, as illustrated in Figure 9. Any alterations or distortions introduced in this process are not within my control, highlighting a need for careful consideration in the use of graphical software for scientific data presentation.

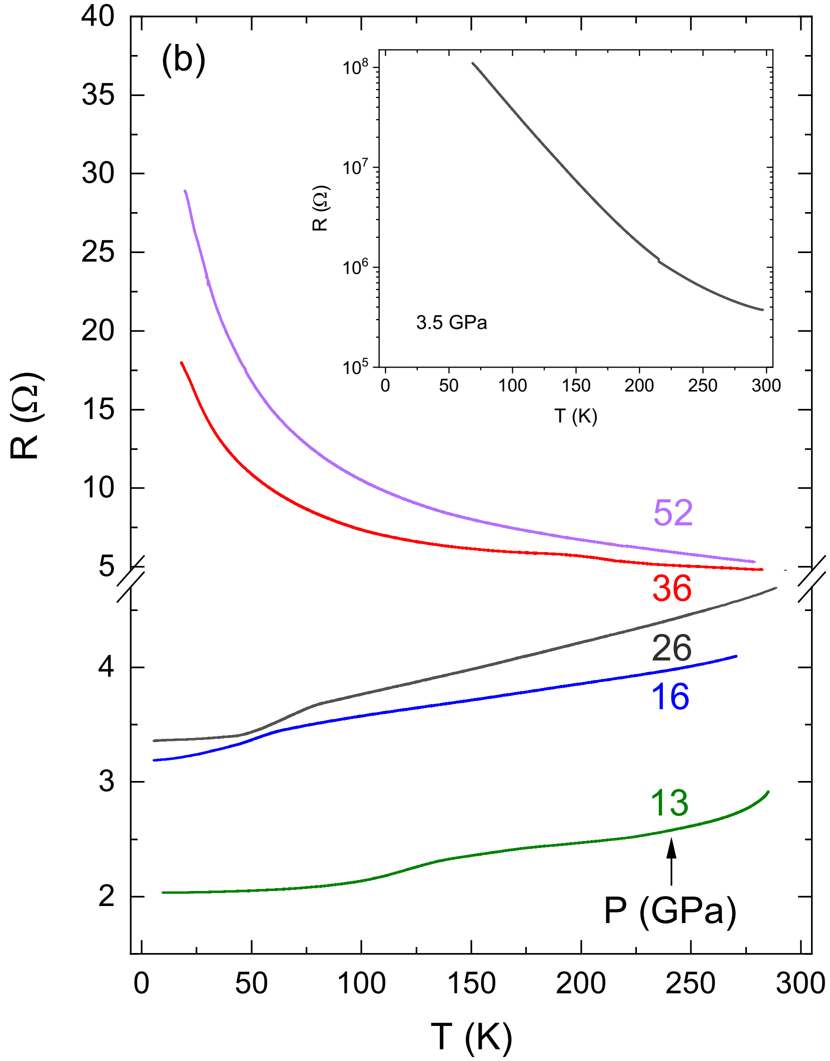


Figure 9. This plot is derived from raw data using Origin Pro software. The data was then supplied to Ashkan Salamat who performed further processing using Adobe Illustrator.

A comparative analysis of the figures produced by the Dias team using Origin software and those by the Salamat team with Adobe Illustrator software demonstrates a remarkable similarity in the 13 GPa data. The data lines for 13 GPa are nearly identical, except for a minor fluctuation (a slight bump rather than the abrupt jump referenced by the Investigation Committee) around approximately 50 K. This minor variation in resistance, as depicted in Figure 10 below, is also observable in the raw data and does not compromise the scientific conclusions presented in the paper. It is also noteworthy that there are discrepancies in the labeling of pressure values and the placement of units in the final submitted version of the figure (Figure 9) compared to the original, indicating alterations made by the UNLV team. Any variances observed because of utilizing Adobe

Illustrator were inadvertent and did not constitute an attempt to deceive or hinder the peer review process of PRL.

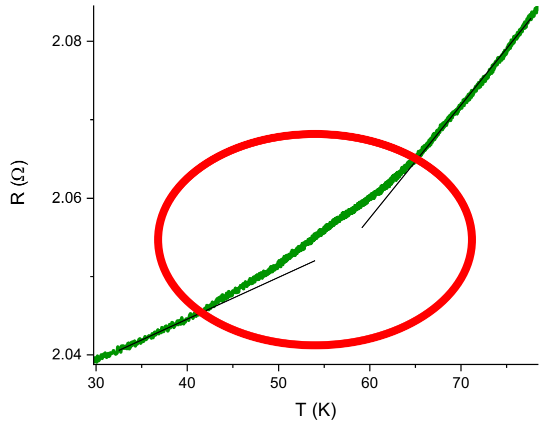


Figure 10. A magnified view of Figure 8, generated from raw data. This figure highlights a minor increase around 55 K, as indicated by the red

b. Conclusion.

In conclusion, the scrutiny of the MnS_2 dataset provided in the PRL 2021 paper, as well as the examination of figures submitted to and published by Physical Review Letters, has elicited significant discussions regarding the integrity and representation of scientific data. It has been established that discrepancies noted by the Investigation Committee between the published data and the dataset submitted for review predominantly stem from graphical modifications made using Adobe Illustrator by Prof. Ashkan Salamat, rather than from inconsistencies in the data itself.

The assertion by the Investigation Committee that data corresponding to pressures of 13, 16, and 26 GPa were fabricated while data for pressures of 36, 52, and 3.5 GPa were validated underscores a selective critique that may not fully account for the nuances of data presentation and analysis. Notably, the Investigation Committee's validation of the 52 GPa data, despite observed graphical distortions, highlights the need for a nuanced understanding of the impact of visualization tools on scientific data representation.

Further examination of figures, particularly around regions of interest such as 30 K and 220 K, reveals that variations observed in the graphical representations do not necessarily denote discrepancies in the underlying data. These observations are crucial in understanding that the application of Adobe Illustrator, while altering the visual presentation, does not inherently distort the scientific validity of the data. Additionally, the identification of supposed data anomalies by the Investigation Committee, based on comparisons with unrelated datasets, calls for a more thorough and independent verification of data integrity.

The side-by-side comparison of figures generated by different teams using different software tools elucidates the fact that minor fluctuations observed in the data (e.g., a slight bump around 50 K) are consistent with the raw data analysis and do not detract from the scientific findings of the paper.

Discrepancies in the visual representation of data, attributed to the use of Adobe Illustrator, were unintended and do not reflect an attempt to mislead the peer review process.

Given these considerations, it is imperative for the Investigation Committee and all stakeholders to approach the findings with an open mind, recognizing the complexities involved in scientific data presentation and analysis. I advocate for a collaborative and constructive dialogue, emphasizing the importance of scientific integrity and the benefit of doubt in the pursuit of truth. This approach is essential not only for resolving the current discrepancies but also for fostering an environment of trust and transparency in the scientific community.

2. Figure 1b, R(T) Data (Resistance as a Function of Temperature) Was Not Fabricated nor Falsified.

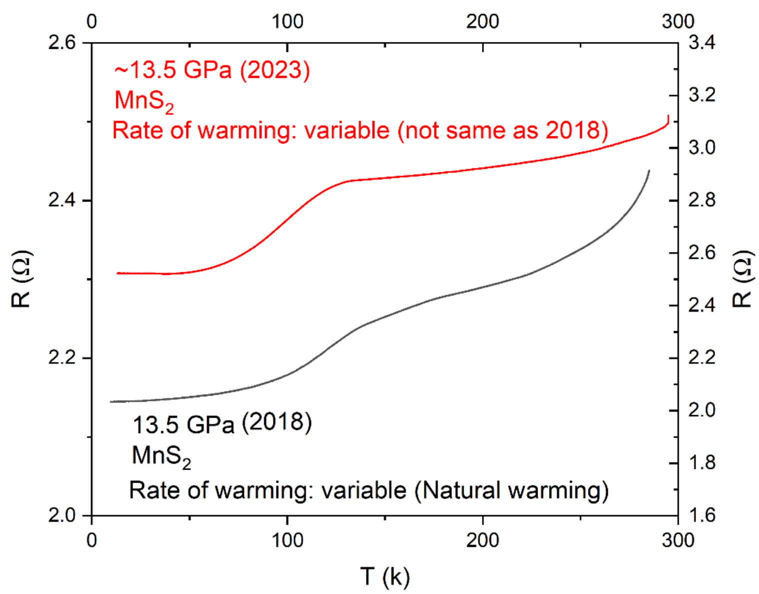
In this section, we delve into the critical examination and validation of resistance measurements for MnS_2 under high pressure, specifically addressing allegations of data fabrication and improper replication with regards to previously published GeSe4 data. Recent experimental efforts undertaken by researchers, including detailed measurements conducted by Michael Bartusek and Sasanka Munasinghe, have played a pivotal role in refuting claims of data manipulation. By presenting new experimental findings and comparative analyses between MnS_2 and GeSe4 datasets, this section aims to clarify the integrity of the MnS_2 data at 13.5 GPa and address the notable discrepancies highlighted by the committee. Through meticulous analysis and replication of experiments, we seek to elucidate the nuances of the MnS_2 sample behavior under pressure, particularly focusing on the alleged similarities and the critical differences in resistance behavior around 50 K, thus reinforcing the original findings and contributing to the broader scientific discourse on the matter.

a. Validation and Replication of MnS_2 Sample Resistance Measurements Under High Pressure.

One of the primary accusations by the Investigation Committee in this section was that the MnS_2 13 GPa data was copied or fabricated from GeSe4 data. Considering these allegations regarding data fabrication and the illegitimate replication of GeSe4 low-temperature resistance measurements, it is essential to meticulously examine the integrity of the resistance as a function of temperature (R(T)) data presented for MnS2 at 13 GPa. To address these concerns, this section introduces new experimental evidence on the resistance of MnS2 samples at low temperatures, meticulously conducted by Michael Bartusek and Sasanka Munasinghe during the summer of 2023. The findings from the 13.5 GPa conductivity experiments on the MnS2 sample are depicted in the subsequent figure.

The recent investigations undertaken on the MnS_2 sample at 13.5 GPa—a focal point of scrutiny—reveal significant insights, notably the insulator-to-metal transition observed under high-pressure conditions. This transformation is primarily corroborated by the observations in Fig 2a of the initial publication, with additional support from Fig 1b, which illustrates the sample's metallic nature under such pressure. To further substantiate these findings, we conducted repeat experiments measuring the low-temperature resistance of MnS_2 at an approximate pressure of 13.5 GPa. These repeated measures confirmed the metallic behavior previously reported in the 2021 Physical

Review Letters (PRL) article. The experiments were performed at a constant warming rate of 1.5K/min (See Figure 1, bottom), and the resistance profile obtained closely aligns with the original MnS_2 study, barring some discrepancies in the high-temperature range. It is noteworthy that the original data collection employed a natural, which is a variable warming rate, contrasting with the constant rate used in the repeated experiments. This variance in methodology and its implications are further explored and depicted in Figure 1 (top), presenting an initial foray into these comparative analyses.



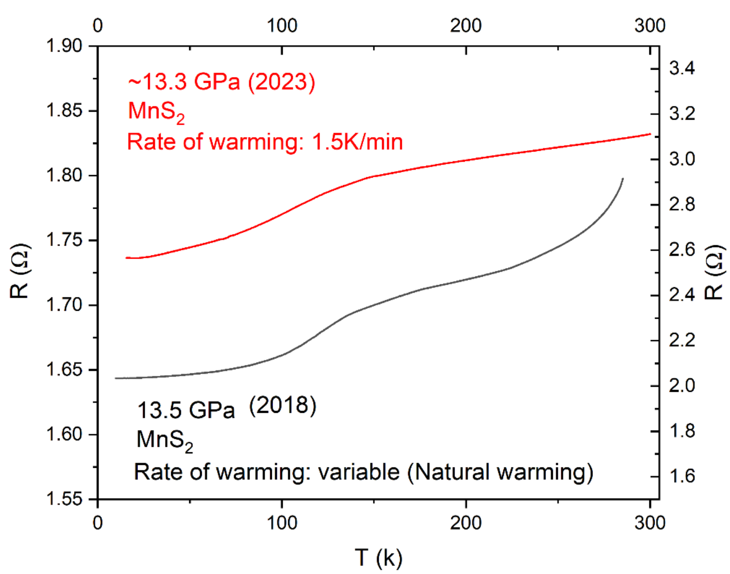


Figure 1. Outcomes of recent experimental investigations on the MnS_2 sample subjected to a pressure of 13.5 GPa, a condition that has elicited significant scrutiny. (Top) The experiments utilized a variable warming rate, diverging from the natural warming approach employed in the original MnS_2 studies. (Bottom) This figure also includes results from the same experimental setup, albeit with a cooling rate maintained at 1.5 K/min, offering a comprehensive comparison of thermal management techniques applied during the study.

b. There are Conspicuous and Significant Distinctions Between the GeSe4 Data and the MnS_2 Data That Have Been Ignored by the Investigation Committee.

The second critical point that demands attention concerns the allegations of a remarkable resemblance between the MnS_2 data at 13.5 GPa and the GeSe4 data, particularly highlighted by the Investigation Committee due to a discontinuity observed around ~50 K. The Investigation Committee posited that the presence of identical features in the datasets of two distinct materials at a similar temperature range was implausible. I argue, however, that such parallels can indeed emerge when the data is derived from analogous experimental configurations. Importantly, our thorough examination reveals the absence of any abrupt discontinuity in the MnS_2 dataset around ~50 K.

Referencing the below Figure 2, which illustrates the MnS_2 data ultimately included in the publication, it is important to note that this figure is based on the identical dataset reviewed pre-publication by the Investigation Committee and subsequently submitted to PRL. The area highlighted by a red circle indicates the point of interest where the GeSe4 data exhibited a discontinuity. To facilitate a closer examination of this specific region, Figure 3 provides an enlarged view of the 13.5 GPa MnS_2 data around ~50 K, allowing for detailed scrutiny.

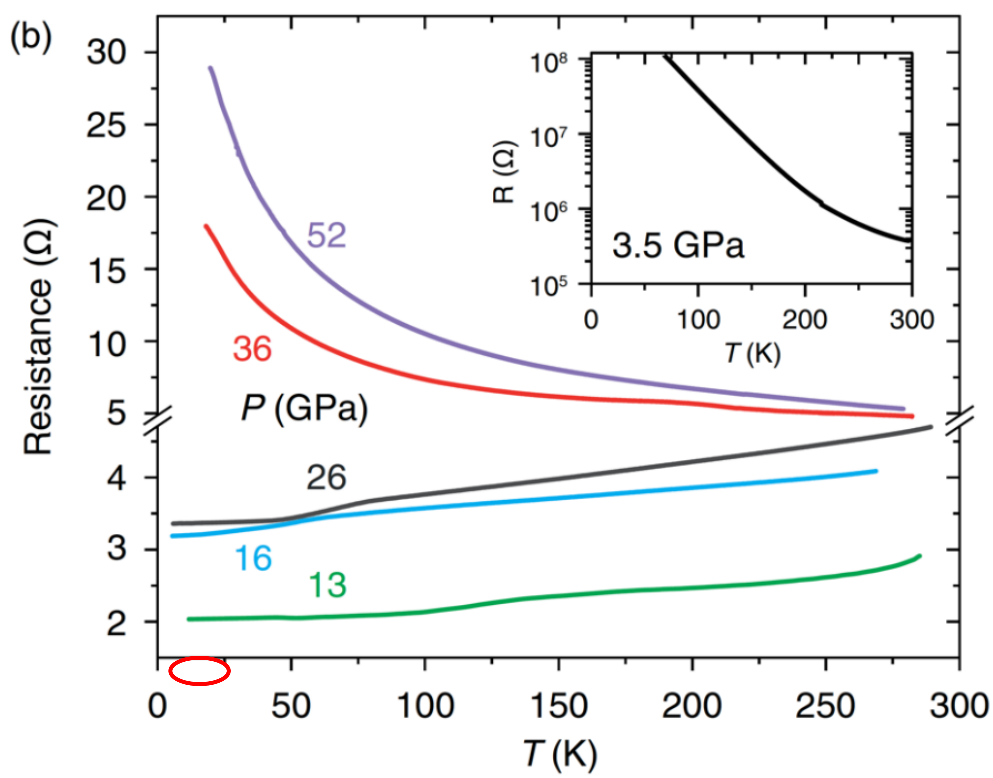


Figure 2. The final figure submitted to PRL and subsequently published.

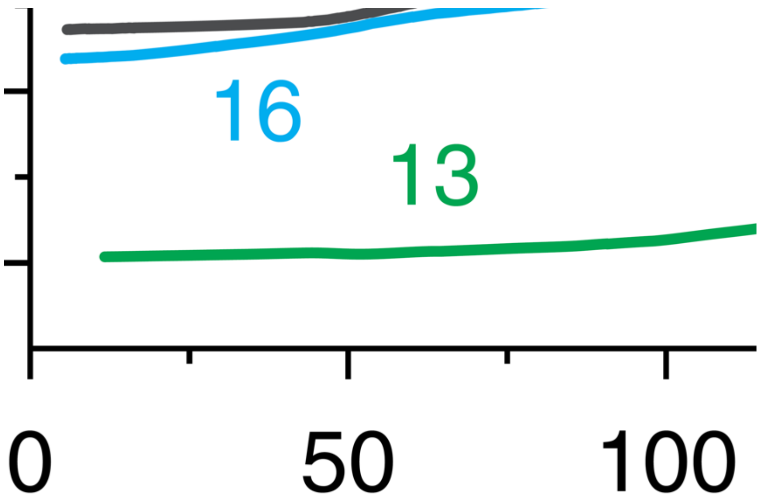


Figure 3. Zoomed in version of 13.5 GPa MnS_2 data at low temperatures. Clearly, there is no abrupt jump or discontinuity around 50K.

Now, let's examine the detailed view of the GeSe4 data around the same temperature range. Refer to Figure 4.

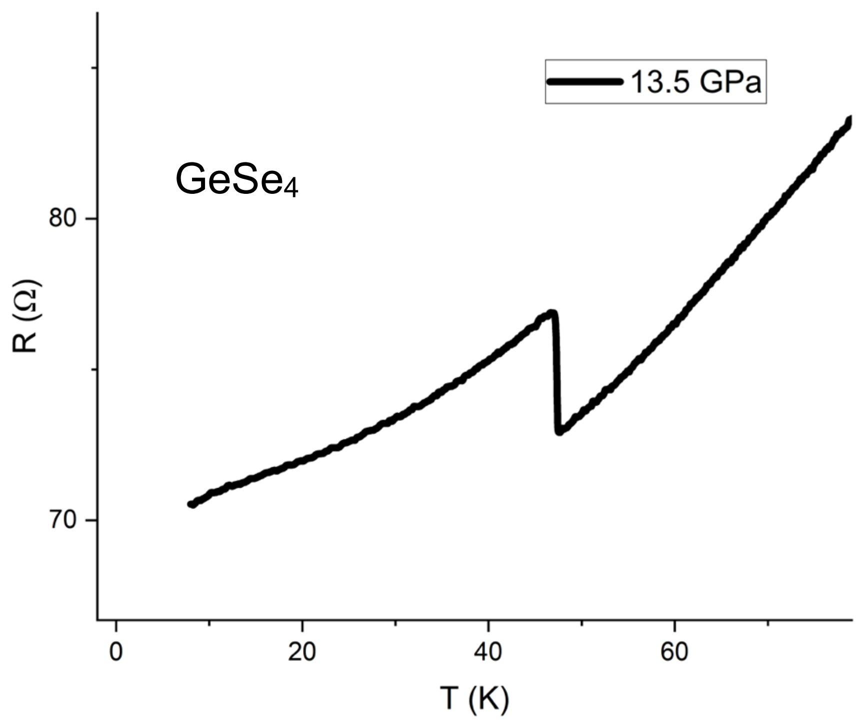


Figure 4. Zoomed in version of 13.5 GPa GeSe4 data at low temperatures. Clearly, there is discontinuity around 50K. This is without a clear abrupt change in resistance.

A careful comparison of Figures 3 and 4 by anyone possessing fundamental understanding reveals unequivocally that the datasets are not identical. It appears that the Investigation Committee merely adopted the unscrutinized analysis of James Hamlin. However, it should now be very clear that there are conspicuous and significant distinctions: the GeSe4 data display a sudden shift, whereas the MnS2 data do not exhibit such a change around 50 K. Consequently, the Investigation Committee's assertion that both datasets are the same is herein conclusively refuted.

c. The “Mapping Approach” Adopted by the Investigation Committee is Flawed.

The methodology, termed the "mapping approach," employed by the Investigation Committee has created a significant point of contention. This strategy has been adopted by the Investigation Committee so that it could replicate data with accuracy up to five decimal points using this technique. It is crucial to critically evaluate the Investigation Committee's use of a "mapping approach," which relies on a bespoke mathematical formula to transform data from one dataset to another. Specifically, this method purportedly enabled the derivation of MnS_2 data from existing GeSe4 data, demonstrating that any dataset can be mathematically manipulated to mimic another set of data pertaining to a completely different material. To illustrate this argument, Figure 5 has been introduced, showcasing how a distinct mathematical formula was applied to generate the MnS_2 2021 dataset from the GeSe4 2013 data. This example underscores the inherent flaw in the "mapping approach," highlighting its potential to artificially create comparable datasets for disparate materials, thereby questioning the validity of such a method in authentic scientific inquiry.

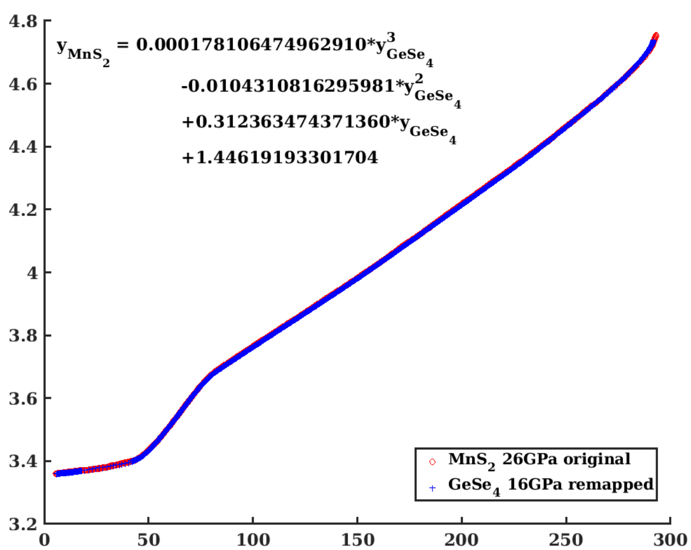


Figure 5. Mapping using a third order polynomial. We can generate accuracy of more than 5 decimal points.

To provide additional insight, we have developed an alternative formula that yields identical outcomes, as demonstrated in Figure 6. This demonstration is intended purely to highlight the capability of formulating and applying mathematical strategies for the manipulation of datasets across various materials. It is imperative to emphasize that this methodology bears no relevance to our MnS_2 publication. Furthermore, the GeSe4 data from 2013 had no influence on the MnS_2 data

submitted to Physical Review Letters in 2021. Our ability to achieve precision beyond five decimal points underscores the fact that the Investigation Committee's endorsement of this approach is fundamentally flawed and devoid of scientific validity.

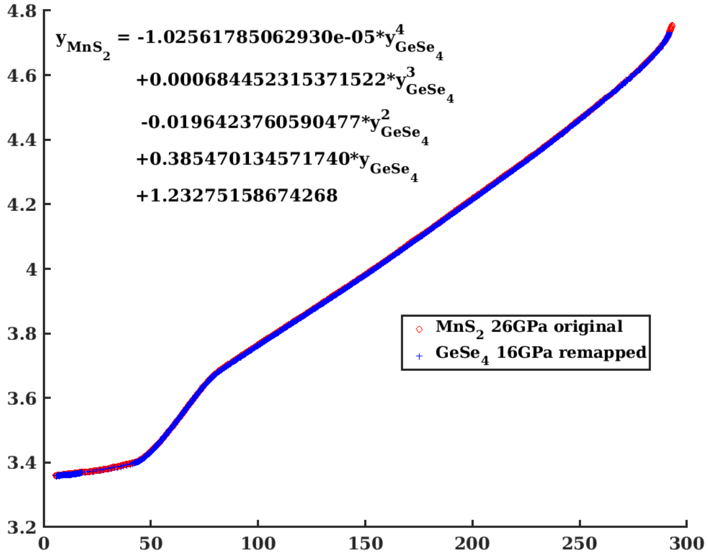


Figure 6. Mapping using a fourth order polynomial. We can generate accuracy of more than 5 decimal points.

To contextualize the analysis detailed herein, it is essential to delineate the methodologies employed by Dr. Hamlin to support his allegation that the authors duplicated data. Dr. Hamlin scanned data from both studies, noting temperature intervals approximately every 5 K. Utilizing the scanned datasets, he conducted a singular R(T) measurement for each compound under scrutiny. Notably, Dr. Hamlin proceeded to adjust the datasets by subtracting their respective zero temperature values, despite a significant disparity, with a difference factor of 35. Subsequently, he endeavored to normalize the data further by dividing by R(120 K), where the resistance values of the two materials diverged by a factor exceeding 260. This process of normalization, also mirrored by the Investigations Committee, aimed to equate the datasets of inherently distinct compounds.

Dr. Hamlin's approach to normalization allowed for an analysis confined primarily to the lower one-third of the temperature spectrum, acknowledging the presence of many metals with minor temperature dependencies within this range. This methodological choice highlights a focused concern on a narrower temperature window of approximately 60-70 K, representing less than one-quarter of the full temperature scale under consideration. Through this selective analysis, Dr. Hamlin's techniques appear to be crafted to corroborate a specific, anticipated outcome, a strategy similarly adopted by the Investigation Committee. This raises critical questions regarding the scientific rigor and objectivity of the methodologies utilized in their comparative analysis.

d. Questions Raised by the Investigation Committee's Adoption of James Hamlin's Limited Analysis.

Dr. Hamlin's approach is particularly concentrated on a characteristic observed between 40-50 K, where he posits that the degree of similarity and/or overlap between datasets significantly exceeds the bounds of mere coincidence. Yet, he concedes that this resemblance does not persist beyond 120 K. This concession prompts several probing inquiries:

i. Why would a scientist copy nearly a decade old data over only one-third of the temperature range on a single R(T) curve?

ii. What does the 'noise' of the datasets look like?

iii. How much of a coincidence would it be for two materials to exhibit similar R(T) over a narrow window of the whole measurement? Would one expect these two materials to exhibit similar behavior? If so, why?

iv. What should one expect above 120 K on the MnS_2 data above 120 K if data was falsified (chronologically the implication is that the MnS_2 data was artificially generated from the previously measured GeS_4 data)?

v. Why would there be a jump in R(T) at 40 K? First could there be a physical explanation? Could it be an artifact?

The ensuing analysis aims to furnish insights and explanations to each of the questions identified above.

i. Why would a scientist copy nearly a decade old data over only one-third of the temperature range on a single R(T) curve?

This question might be rhetorical, but let's enlist Occam's razor. The accusation leads to the suggestion that the authors took one-third of nearly a decade old dataset on only one compound and deliberately added some other R(T) behavior at higher temperatures? The data serves as indirect supporting evidence for the insulator-metal transition. Figure 1a from the original PRL paper already supports this claim, and the low-temperature data merely serves as additional evidence. It's difficult for me to imagine any benefit from copying data for another publication that does not introduce any new findings to the study. In any event, recognizing the benefit of the doubt in favor of the authors and in favor of scientific integrity, we considered alternative answers to the question.

Our investigation indicates that Dr. Hamlin scanned numerous R(T) curves from our studies, identifying two with a potentially 'suspicious' degree of overlap, as he terms it. Dr. Hamlin's conclusion that the data were duplicated is illustrated in Figure 7. This figure, which plots the raw data on a logarithmic scale for enhanced clarity, starkly contrasts the resistance magnitudes. Additional plots, normalized by subtracting the lowest temperature resistance and normalizing at various temperatures (T=60 K, 120 K, 180 K, 240 K, and 285 K), were constructed. Notably, the T=120 K normalized plot, as highlighted by Dr. Hamlin, shows significant overlap, particularly in the range from 60 K to 120 K—excluding the 0-50 K interval where minimal

temperature dependence is universally acknowledged. Among the five normalized renditions of the dataset, it is only the 120 K normalization that exhibits such pronounced congruence.

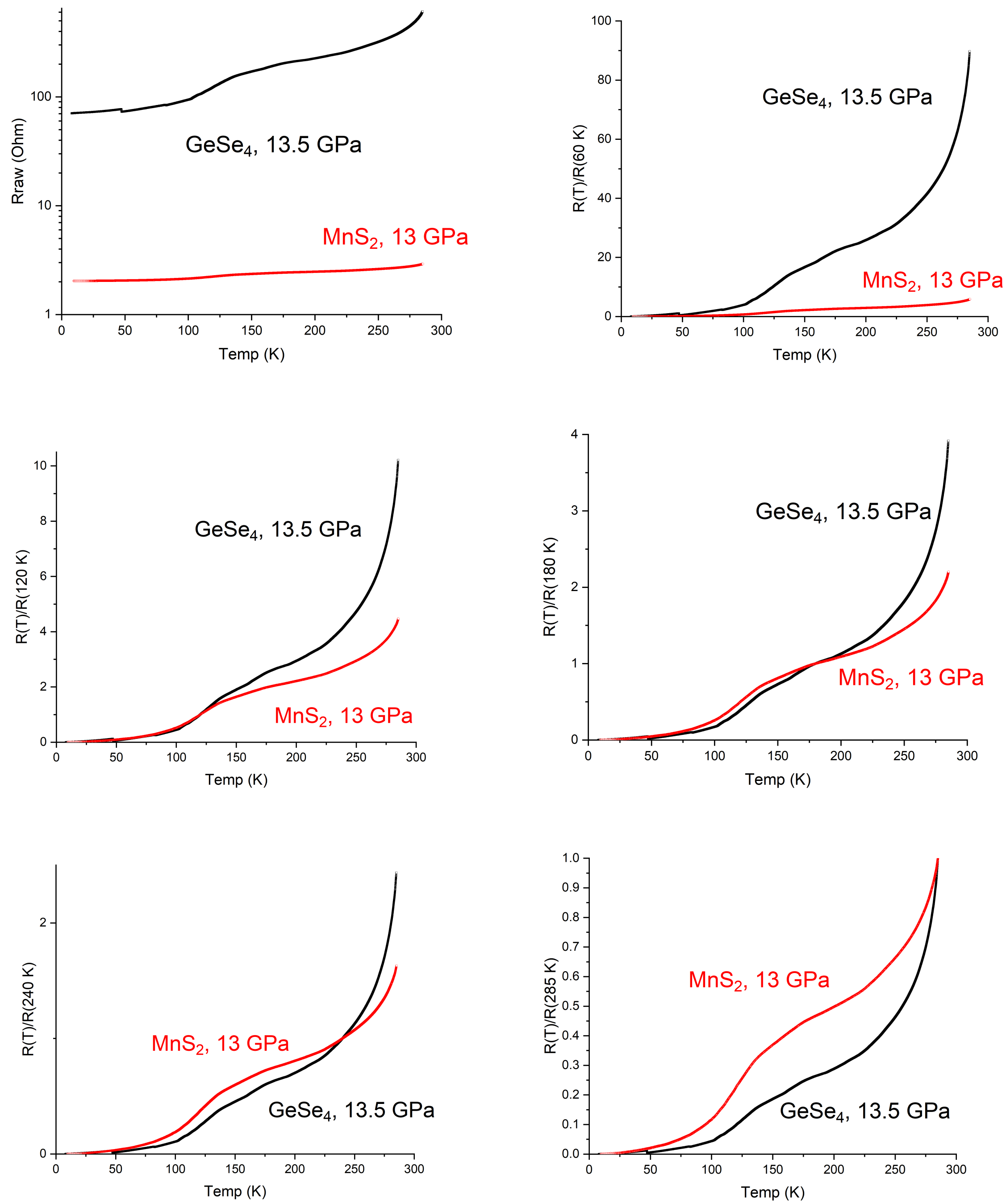


Figure 7. (top left) Raw resistance versus temperature data. Other data plotted after low tempearture resistance subtratced and normalized by the value resistance at 60 K, 120 K, 180 K, 240 K and 285 K.

At this point, it becomes imperative to delve into the effects of "normalizing and comparing data," a methodology employed by Dr. Hamlin, and its potential to create perceptions of data overlap. In pursuit of this understanding, we embarked on an analysis of pure samples of the transition metals cobalt (Co), iron (Fe), and nickel (Ni) to evaluate their behavior under similar scrutiny. For this analysis, experimental data was sourced from the work of Price and Williams, specifically from tabulated numerical values found in the 1982 CINDAS LLC Aerospace and High Performance Alloys Database – Report 60 - Version 1.6, available at http://cindasdata.com/. Figure 8 presents our findings, with the top illustration revealing that the Co and Ni datasets exhibit notable similarities to the datasets under examination, across a broad temperature spectrum. The bottom diagram in Figure 8 contrasts the Dias data with Fe, normalized at 120 K, within a 60 K temperature window from 50 K to 110 K. The congruence among these three datasets is remarkable, underscoring the coincidental nature of their alignment, particularly in relation to ambient pressure Fe data.

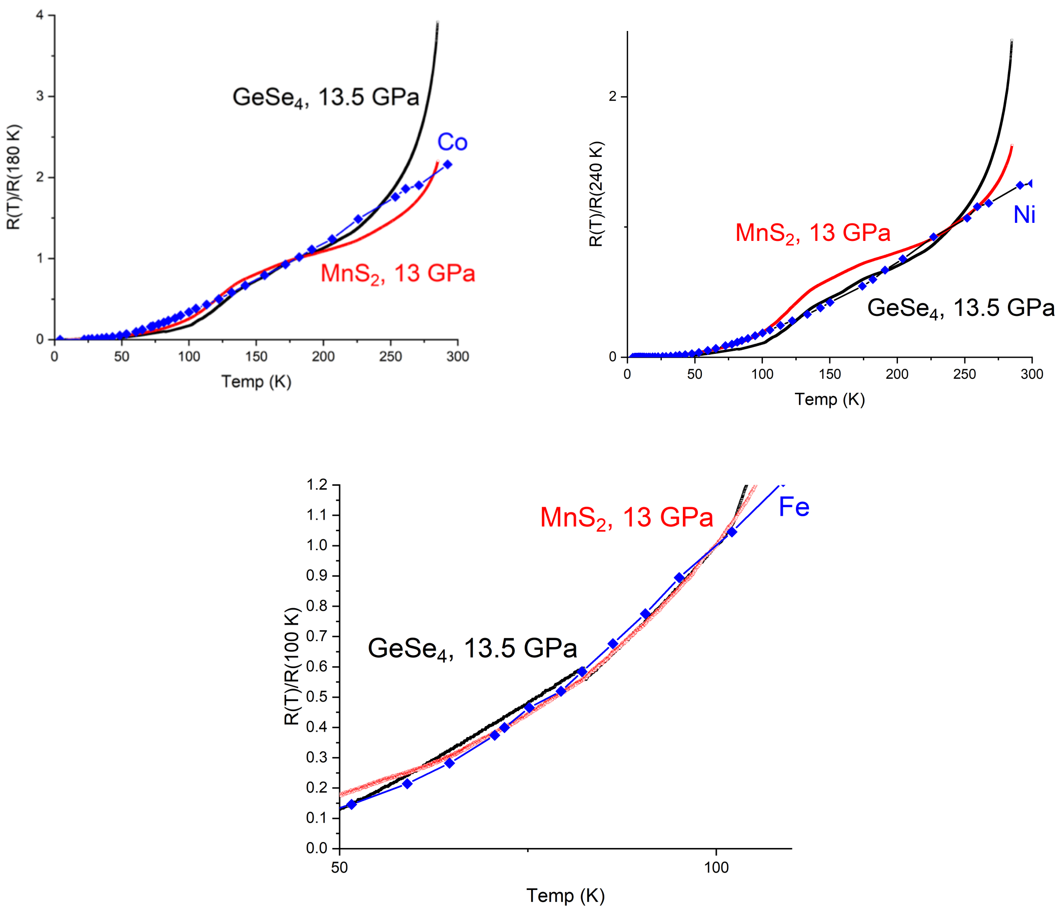


Figure 8. Comparisons of data to transition metals. (Upper Left) Data for MnS_2 and $GeSe_4$ along with Co normalized by the 180 K value. (Upper Right) Data for MnS_2 and $GeSe_4$ along with Ni normalized by the 180 K value. (Bottom) Zoomed in data for MnS_2 and $GeSe_4$ along with FE normalized by the 100 K value.

This observation underscores the fact that the technique of "normalizing and comparing data" possesses the capacity to qualitatively homogenize the appearance of materials that may share similar physical properties. Consequently, a thorough and meticulous analysis is imperative before levying significant allegations such as those presented in this context. It emphasizes the necessity for rigorous scrutiny and evidentiary support when asserting claims of this nature, ensuring that conclusions drawn are both scientifically robust and unequivocally substantiated. Unfortunately, the Investigation Committee has failed undertake such rigorous scrutiny, but instead blindly adopted the flawed approach advanced by Dr. Hamlin.

ii. What does the ‘noise’ of the datasets look like?

This question of understanding what the ‘noise’ looks like is important because if the data was copied, as is claimed by Dr. Hamlin, the exact same scaled “noise” should be observed. Understanding this necessitates an acknowledgment that should the more contemporary MnS_2 (2021) dataset have been derived from the prior GeSe4 (2013) dataset, parallels in experimental noise would be expected. Notably, identifying similarities in experimental noise in purportedly copied data would require examination under uniform conditions using identical equipment.

Our scrutiny of Dr. Hamlin's claim uncovers that he utilized differing equipment, operated under varied temperature conditions, and employed distinct measurement techniques across the datasets. Such disparities enable comparisons under conditions that lack scientific rigor, potentially skewing outcomes towards a predetermined conclusion. Unfortunately, the Investigation Committee again simply adopted Dr. Hamlin’s approach with no scientific scrutiny.

Our analysis extended to conducting varied measurements across the datasets using distinct lock-in amplifiers, specifically the SRS 830 for GeSe4 and the SR 860 for MnS_2, under divergent temperature and measurement conditions. The significance of these differences is underscored by the unique output characteristics of each lock-in amplifier, with the SR 830 exhibiting a distinctiveness in output compared to the SR 860. To elucidate this point, we executed simultaneous R(T) resistance measurements, distributing the signal equally between an SR 830 and an SR 860. The findings depicted in Figure 9, demonstrate that while the raw data appear nearly identical at this scale, a discernible variance is observable in the succession of data points across a specified temperature range. Specifically, the data from the SR 830 exhibit a degree of discreteness not observed in the SR 860 data, highlighting the critical role of equipment selection in the integrity and interpretation of experimental results.

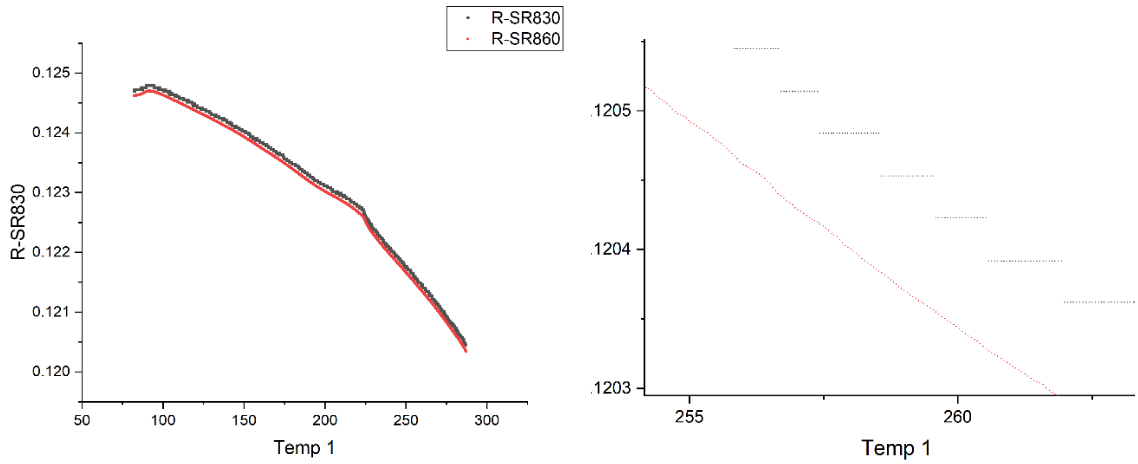


Figure 9 – (Left) Simultaneous R(T) measurement using two different lock-in amplifiers (SR 830 used for $GeSe_4$ work and SR 860 for the MnS_2 work). (Right) The difference in successive data points for the two different measurements. The SR 830 shows discreteness and the SR 860 does not.

Furthermore, it is pertinent to note the significant variance in the quantity of data points collected per experimental run: approximately 25,000 to 26,000 for GeSe4 using the SRS 830, compared to 12,000 to 16,000 for MnS_2 with the SR 860. These discrepancies are not trivial and warrant careful consideration in the context of Dr. Hamlin's allegations of data duplication. This critical aspect was previously communicated to Dr. Hamlin in our preceding report, where we underscored the differences in the x-components of the datasets as illustrated in Figure 9. It is crucial to recognize that the warming rates employed in each resistance measurement serve as distinctive identifiers for each experiment, further emphasizing the uniqueness of each dataset and challenging the premise of data replication.

As an initial observation, the 'noise' characteristic within the datasets is illustrated in Figure 5, wherein we delineate the variance between successive resistance measurements. The data for GeSe4 (2013) distinctly exhibit discrete steps, attributable to the utilization of the SRS 830 lock-in amplifier, which 'digitizes' the data alongside minimal temperature increments. This phenomenon accounts for the absence of a noticeable gradient in Figure 10, contrary to what is observed in Figure 9 where larger temperature steps are employed. In instances where the derivative of resistance with respect to temperature, dR/dT, is sufficiently large (exceeding 100 K) for the GeSe4 at 13.5 GPa, a noise pattern akin to that typically observed in MnS_2 measurements emerges, owing to the differential between successive data points surpassing the threshold of discreteness.

Conversely, the continuous data pattern associated with MnS_2 can be attributed to the employment of a different lock-in amplifier, the SR 860, coupled with greater temperature intervals between measurements. The critical insight from Figure 10 is the evident utilization of distinct lock-in

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amplifiers for the two studies, each imparting a unique 'noise' signature to the raw data. This observation underscores that a mere rescaling of the GeSe4 data would not replicate the MnS_2 dataset, as identical scaled 'noise' patterns would be expected in such a scenario, highlighting the technical and methodological nuances in the experimental setups of the two materials.

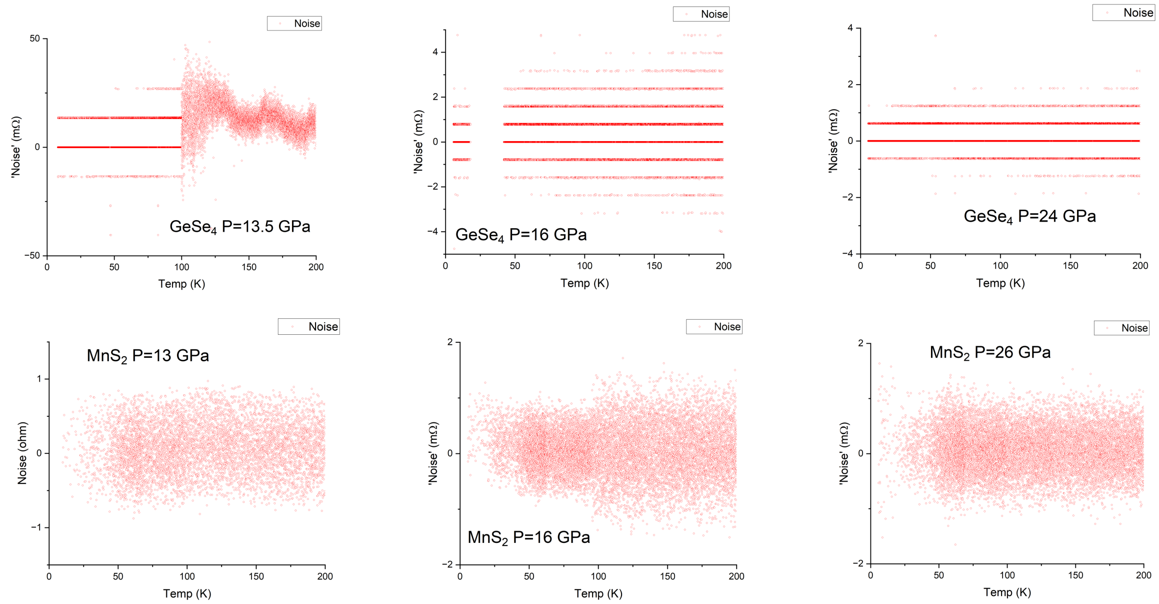


Figure 10. The 'noise' in the various measurements where the noise is just calculated as the differene between succesive measurements.

To elucidate, should the GeSe4 (2013) dataset have been appropriated for the MnS2 (2012) dataset as asserted by Dr. Hamlin, an identical scaled 'noise' pattern would be anticipated. The absence of such congruence in the 'noise' characteristics conclusively indicates that the datasets were not replicated from one another. Furthermore, Dr. Hamlin's approach, characterized by the employment of disparate equipment, varying temperature regimes, and different measurement methodologies across the datasets, lacks scientific rigor. Consequently, these methodological discrepancies undermine the reliability of his claims, which are further discredited by the detailed analysis of the 'noise' patterns. This comprehensive examination substantiates the conclusion that the allegations of data duplication do not hold merit, underscoring the importance of consistent experimental protocols in the validation of scientific findings.

iii. How much of a coincidence would it be for two materials to exhibit similar R(T) over a narrow window of the whole measurement? Would one expect these two materials to exhibit similar behavior? If so, why?

It is widely recognized within the scientific community that various metals can display significant overlaps in resistance as a function of temperature (R(T)) across broad temperature ranges under specific experimental conditions. This observation holds especially true when comparing datasets derived from different equipment, under varying temperature conditions, and through diverse

measurement methodologies. As illustrated in Figure 8, such overlaps are not uncommon and can be attributed to intrinsic material properties and the conditions under which data is collected and analyzed.

In the context of Figure 7, both chalcogenide systems examined exhibit a phase transition slightly above 10 GPa, transitioning into a metallic state accompanied by a volume reduction of approximately 20%. In this metallic phase, the pressure-volume (P-V) curves of both systems indicate similar compressibility behaviors, suggesting comparable phonon energy distributions. The high-pressure phase of MnS_2 is characterized by low symmetry, while GeSe4 assumes an amorphous structure. Given these conditions, large pressure gradients in transport measurements could result in 'washed-out' resistance behaviors for both materials, a phenomenon that is not unique to these systems but also observed in high-pressure studies of GeS_2 and SnS_2.

A cursory review of existing literature reveals additional chalcogenides, such as Mg-Si, where the R(T) behavior is hard to deduce as the data is plotted as logR versus 1000/T, and HfS_2, that undergo pressure-induced metallization near 10 GPa, further supporting the notion that similar R(T) behaviors can emerge under comparable high-pressure conditions. For instance, Figure 11 contrasts the R(T) profiles of GeSe4 under various pressures with that of HfS2 at 60 GPa, demonstrating a notable similarity between the 16 GPa GeSe4 data and HfSe2 data at approximately 100 K when R is normalized at 240 K.

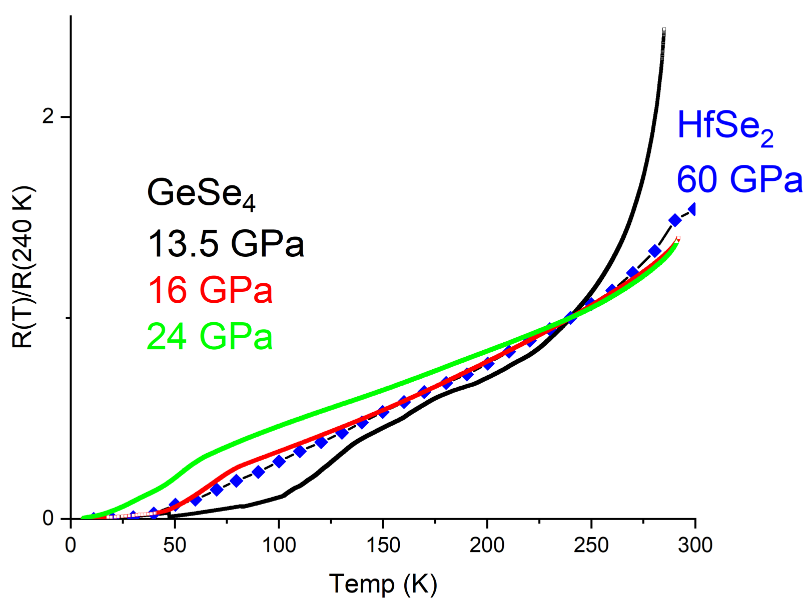


Figure 11. R versus T data for the three $GeSe_4$ pressure and published data at 60 GPa for $HfSe_2$.

This convergence in qualitative resistance responses among materials with analogous physical properties underlines a fundamental aspect of high-pressure physics. Such similarities underscore the importance of considering the specific experimental setup and material characteristics when interpreting resistance measurements, thereby affirming the plausibility of observing congruent R(T) behaviors across different materials within defined measurement windows.

iv. What should one expect above 120 K on the MnS_2 data if data was copied (chronologically the implication is that the MnS2 (2021) data was artificially generated from the previously measured $GeSe_4$ data (2013))?

In evaluating the MnS_2 dataset within the framework of Dr. Hamlin's allegation of data replication, a critical analysis must lead to one of two theoretical outcomes, assuming the data below 120 K were derived by duplicating and adjusting the GeSe4 dataset. Beyond the threshold of 120 K, the potential scenarios include: (1) the incorporation of data from an entirely distinct experimental process, or (2) the application of a scaling adjustment to the GeSe4 data. Under either circumstance, one would anticipate observable anomalies, such as a pronounced shift in the derivative of the resistance curve above 120 K, indicative of data manipulation.

An analytical examination, as demonstrated in Figure 12, which presents the derivative of the MnS_2 resistance data at 13 GPa, reveals the absence of any discontinuity or abrupt alteration in slope within the temperature range extending beyond 120 K. This uniformity in the data's trajectory serves as compelling evidence against the notion of data fabrication. The continuity and consistency observed in the slope of the MnS2 dataset above 120 K conclusively demonstrate that the dataset was not subject to the alleged copying and modification from the earlier GeSe4 data (2013), underscoring the integrity of the MnS2 (2021) dataset's experimental results.

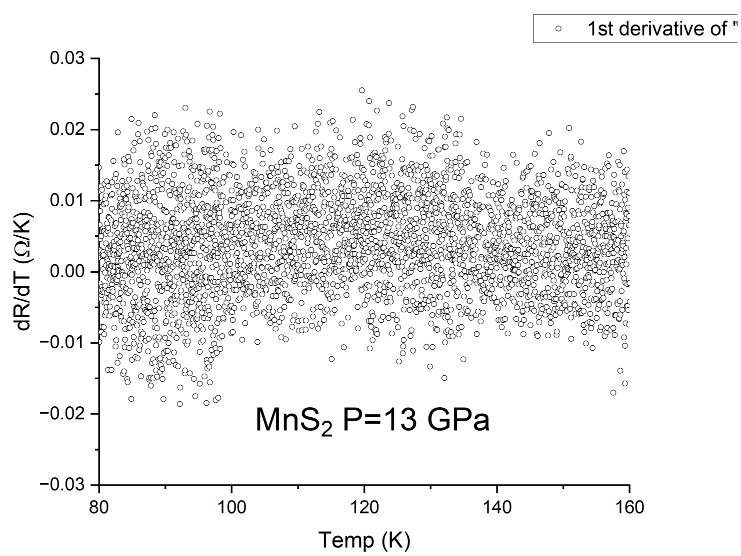


Figure 12. The derivative of the raw R(T) data for MnS_2 at 13 GPa from 80-160 K

The analysis of the MnS_2 dataset, specifically examining the continuity of the derivative of resistance data beyond 120 K, conclusively disproves the allegation of data replication from the GeSe4 dataset. The absence of any discernible break or sudden change in slope within this critical temperature range firmly establishes the authenticity of the MnS_2 (2021) dataset. This finding, grounded in the detailed scrutiny of experimental data, reaffirms the scientific integrity of the MnS_2 study and negates the claim of data fabrication from previously measured GeSe4 data (2013).

v. Why would there be a jump in R(T) at 40 K? First could there be a physical explanation? Could it be an artifact?

The observed discontinuity in resistance as a function of temperature (R(T)) at 40 K within the datasets of MnS2 at 26 GPa and GeSe4 at 16 GPa, both situated just above the metallic transition, prompts an examination of potential underlying causes. Given that the samples are not homogeneous and are subjected to stress, the emergence of this feature merits a detailed investigation. The temperature of 40 K coincides with a region where the rate of change of resistance with respect to temperature, dR/dT, begins to increase significantly in many samples, suggesting that stress distribution within the samples could exert a pronounced impact at this juncture.

This phenomenon is not isolated to MnS_2 and GeSe4 alone. For instance, the doctoral thesis of Dias on GeS_2 (referenced as Figure 5.8) illustrates a similar behavior just above its metallization pressure of approximately 40 GPa, with multiple curves exhibiting analogous features around this temperature range. Furthermore, an array of chalcogenide materials, as showcased in Figure 13, demonstrates a distinct 'feature' within the 40-60 K temperature range, indicating a possible commonality among these materials under specific conditions. This observation suggests that the jump in R(T) at 40 K could potentially be attributed to intrinsic physical properties and stress effects inherent to these materials, rather than merely being an experimental artifact.

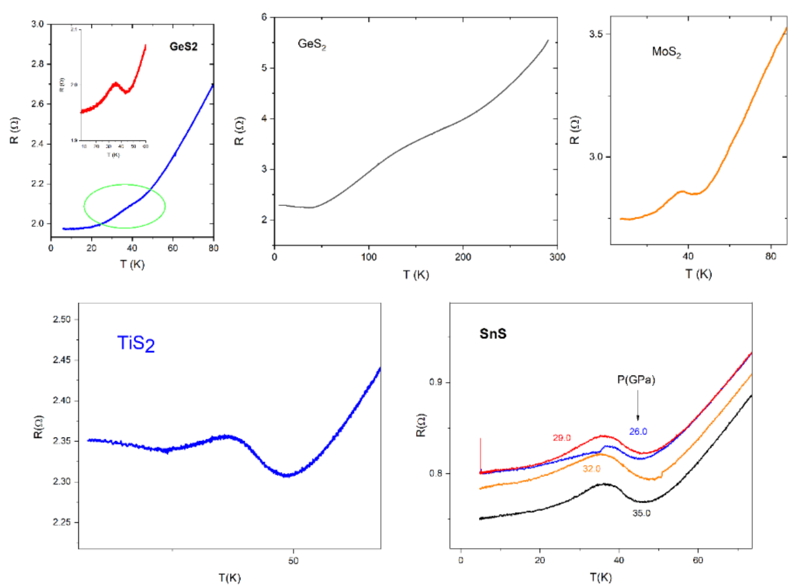
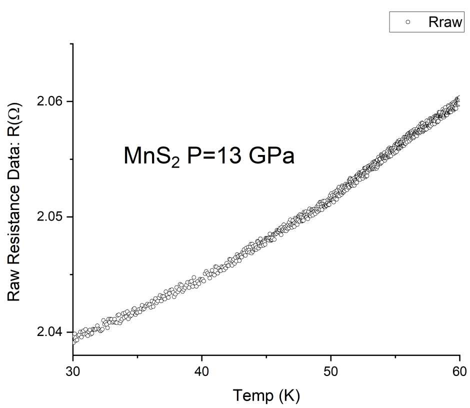


Figure 13. Many examples of chalgonide materials showing a resistance bump in the 40-50 K range.

A pivotal aspect of Dr. Hamlin's allegation centers around the identification of a specific feature within the 40-50 K temperature range, which he posits as evidence of data manipulation. This feature is indeed observable in the GeSe4 dataset, as well as in other systems referenced in his analysis. Such occurrences could potentially stem from experimental artifacts related to the setup utilized at Washington State University, or, more feasibly, from genuine effects associated with sample strain. Nonetheless, this assertion does not hold for the MnS_2 dataset.

Figure 14, which presents the unaltered raw data and its derivative across the 30-60 K range, unequivocally demonstrates the absence of the alleged 'feature' within this temperature interval, in stark contrast to the features reported by Dr. Hamlin in his scanned data. This discrepancy is of paramount importance, highlighting a critical consideration: the methodology employed by Dr. Hamlin to derive "data" from graphical images via software tools may inadvertently introduce erroneous features or, in more egregious cases, facilitate the creation of selective artifacts.

Given that the Investigation Committee mirrored Dr. Hamlin's approach in their analysis, the concerns raised regarding data falsification or fabrication lack substantive foundation. This revelation underscores the necessity for rigorous methodological standards in data extraction and interpretation to prevent the inadvertent introduction of artifacts, thereby ensuring the integrity of scientific inquiry and analysis.



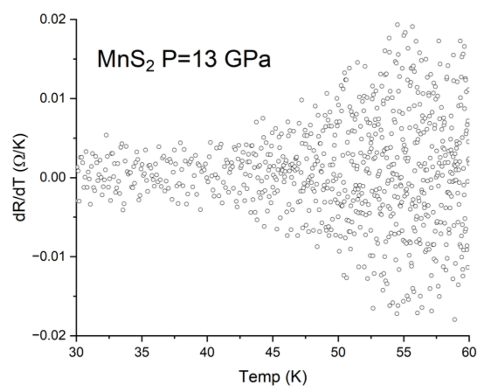


Figure 14. (Left) The raw R(T) data for MnS_2 at 13 GPa from 30-60 K. (Right) The derivative of the raw R(T) data in the lefthand figure.

e. Conclusion.

Based on our investigation and analysis as discussed above, there is no realistic scientific approach that supports Dr. Hamlin's accusation that MnS_2 data (2021) was copied from the GeSe4 data (2013). My comprehensive investigation and analysis have systematically dismantled the basis for Dr. Hamlin's allegation that the 2021 MnS_2 data was derived from the 2013 GeSe4 data. The hypothesis put forth by Dr. Hamlin necessitates the acceptance of a highly convoluted series of manipulations, beginning with the smoothing of the GeSe4 data to eliminate noise characteristic

of an older model lock-in amplifier, followed by a precise scaling and adjustment of resistance values to force congruence at specific temperature points.

This purported method, which also includes the artificial introduction of noise patterns associated with a newer lock-in amplifier model, fails to convincingly replicate the comprehensive temperature range and specific features of the published MnS2 data, notably:

- The discrepancy in the scaled data's magnitude at room temperature, diverging by a factor of approximately ~ 2.5;
- The absence of the distinctive 40-50 K feature in the MnS_2 raw data; and
- The non-occurrence of an abrupt resistance jump that is present in the GeSe4 raw data.

Such considerations unequivocally refute the validity of Dr. Hamlin's accusations, underscoring that the Investigation Committee's conclusion, derived through a methodology mirroring Dr. Hamlin's approach, lacks empirical support and scientific credibility. This methodological replication has led to an unwarranted and unsubstantiated conclusion, diverging from the principles of rigorous scientific inquiry.

Additionally, the Investigation Committee's inconsistent stance on data format, specifically the critique of the MnS_2 data presentation as incomplete while simultaneously accepting similarly formatted data from another source as "raw," further undermines the consistency and objectivity of their analysis. This discrepancy in evaluative standards highlights a critical need for clarity and consistency in the assessment criteria applied by the Investigation Committee, reinforcing the necessity for a reevaluation of their conclusions considering these methodological and analytical inconsistencies.

E. Draft Report E. NSF Early Career Award Proposal

I Had No Intention of Taking Credit for the Work of Others in My Proposal and My Inadvertent Omission of Citations Is Not Plagiarism.

As I embark on the preparation of a research proposal, I am acutely aware of the importance of integrity and thoroughness in the background section. This crucial part of the proposal not only lays the groundwork for the research I intend to carry out but also contextualizes it within the wider scientific arena, highlighting its relevance and potential to make a significant impact. It is both customary and essential to cite all sources of information to duly acknowledge previous work and clearly define the unique contribution of the proposed research.

I recognize that in the meticulous process of assembling comprehensive proposals, there might be instances where references are inadvertently missed. It is important to clarify that such omissions, although regrettable, are not indicative of any intention to misrepresent or claim ownership of others' work. Rather, these can occur as a result of the extensive amount of information being synthesized or the intricacies involved in the proposal preparation process. It is noteworthy to mention that the section affected by this oversight constitutes less than 4% of the entire proposal.

Additionally, I would like to emphasize that a primary aspect of my research involved incorporating a third dopant into hydride systems to realize superconductivity at room temperature. Within this framework, I referenced the study by Sun et. al. concerning the Mg-Ca-H system in the background section of my manuscript, ensuring appropriate citation. It is important to note that if there had been any intention to purposefully exclude references, the option to omit the citation of the Sun et. al. paper was available to me; however, I chose not to do so. This decision serves to highlight that any oversight in referencing was unintentional.

To address this issue, I am committed to taking immediate action to identify and incorporate the omitted references into the pertinent sections of my proposal. I fully understand the significance of recognizing all contributions to scientific discourse. Moreover, I will enhance the rigor of our review processes in future submissions to avoid such lapses. This will include a detailed comparison of our literature review with our list of citations and seeking additional peer reviews of our proposal drafts.

In addition to the points previously mentioned, I wish to emphasize that the oversight in citing certain references within the background section of my research proposal does not alter the substantive scope or the anticipated experimental findings of the proposed research. The essence and objectives of our research remain unchanged, and the missing citations do not detract from the originality and potential impact of our work. The affected background section, while crucial for situating our research within the existing body of knowledge, does not influence the experimental design, methodologies, or the expected outcomes of our study.

By rectifying this citation oversight, I intend not only to acknowledge the contributions of previous work but also to reinforce the integrity and credibility of our proposal. The inclusion of these references will provide a more comprehensive and accurate context for our research, without altering its foundational premises or the innovative approaches we intended to employ.

I appreciate the opportunity to clarify this matter and ensure that our proposal is evaluated on its merits, based on the strength of the proposed research and its capacity to advance our understanding of the subject matter. I am dedicated to upholding the highest standards of scholarly rigor and ethical conduct in all aspects of our research and look forward to contributing valuable insights to our field.

I am grateful for the understanding of the National Science Foundation and the broader scientific community as I endeavor to amend this mistake and ensure that our proposal adheres to the stringent standards required for scientific research funding.

F. Evidence of the University of Rochester's Pre-Determined Outcome Driven Investigation

For incontrovertible evidence of the University of Rochester's pre-determined outcome driven investigation, one only need to question why all the other co-authors have been absolved of any accountability for their contributions to the research that has been questioned by the Investigation Committee. The process of concealing the University's outcome driven approach to this investigation, the Investigation Committee has portrayed the co-authors as "victims". This characterization is nothing short of fictitious.

1. Portraying the Co-Authors as "Victims" Undermines Their Substantial Pre- and Post-Publication Contributions and Support of the Data and Scientific Conclusions.

With particular attention to the LuHN Paper that is the subject of the investigation, various emails from various co-authors demonstrate their substantive involvement in the preparation of the LuHN paper as well as their support for the publication of the paper after extensive scientific discussion and debate about various aspects of the paper. Some of these communications took place prior to the submission of the paper for publication and some took place after publication and were in direct response to criticisms from the scientific community.

a. Pre-Publication Co-Author Communications.

Nathan D.G. nathandasenbrockgammon@gmail.com Sun, Feb 5, 2023 at 5:09 PM
To: Ranga Dias <rangadiaz@gmail.com>

…Very exciting, finally accepted! Here are my minor comments, it is well polished at this point:

- There are a few inconsistencies in unit formatting, most of the paper is 'value space unit' but a few times are 'value dash unit'. Specifically: page 1 the Tcs for CaH6 and H3S, first line on page 5 left "0-kbar" LuH2, first paragraph on page 5 right "0.12-angstrom".
- Page 5 right first paragraph, "but not to the **extant** to provide a better..." should be "**extent"** instead.
- Heat capacity is hyphenated to heat-capacity about half the time. I don't know if Nature wants it hyphenated or not, but right now it is being hyphenated half the time.
- Figure 2 caption: "... 10 kbar using platinum (Pt) metal probes ..." . Throughout the introduction element symbols are used without element names, so might not need both here.
- In the author contributions, I prefer my initials to just be "**N.D.G**" without the hyphen!
- AC susceptibility in the methods section, very last sentence: " cubic polynomial backgrounds were used" change this to "cubic or quadratic ..." just so people don't attack inconsistency between fig 3 caption and methods section.
- Double check extended figure 2, it looks like 2b has two figures that got placed on top of each other in the formatting.

Just so I can be prepared for when it goes public, do you know the publication date yet?

Elliot Snider elliotmsnider@gmail.com Mon, Apr 25, 2022 at 9:17 PM
To: Ranga Dias <rangadiaz@gmail.com>

Hey Ranga,
Not too much to comment on:

- In the abstract: ".... **and then after full recoverability its materials...."** what do you mean full recoverability of its material properties after synthesis?
- I am unsure if you will put the name of the compound in the manuscript. If you plan to keep it confidential, then you should edit the last xray image because it has the stoich in the upper left corner

Nathan D.G. nathandasenbrockgammon@gmail.com Mon, Apr 25, 2022 at 9:56 PM

Overall it looks very good, here are my comments, mostly minor typos and edits:

- page 3, 2nd paragraph, first sentence "rationale" -> "rational"

- The figure 2c inset plots text is a bit too small to read.
- page 8, 2nd paragraph, roughly middle "detecting such a heat anomalies" doesn't need the "a"
- several lines down "the sample is thermally excited by alternating current is applied at..." the second "is" should be removed
- Fig 4a caption "the superconducting signature clearly observed..." needs an "is" so "the superconducting signature is clearly observed..."
- Fig 4 b-d caption "The drive frequency and frequency sweeps of each measurement depicted in the inset" needs an "is" so " "The drive frequency and frequency sweeps of each measurement is depicted in the inset"
- Fig 5 last sentence uses GPa, but the figure and rest of the paper uses kbar
- page 10 paragraph 2 first sentence "evolution" should be plural, since it's two evolutions

Durkee, Dylan ddurkee@ur.rochester.edu Mon, Apr 25, 2022 at 10:11 PM
To: Ranga Dias <rangadiaz@gmail.com>, "nathandasenbrockgammon@gmail.com"<nathandasenbrockgammon@gmail.com>, "Snider, Elliot" <esnider3@ur.rochester.edu>, "Wadhurawa Mudiy, Hiranya"<hwadhura@ur.rochester.edu>, "McBride, Raymond" <rmcbrid5@ur.rochester.edu>

The paper reads well, figures look great. A few comments:

- Nathan pointed out earlier this sentence in the abstract "The compound is synthesized... and then after full recoverability its materials and superconducting properties..." I also think this reads weirdly.
- I am still unclear about what our story is with regards to how Nitrogen is in our sample. I am concerned with how we will handle questions/discussions about the sample synthesis.
- There are a few other sentences I noticed throughout with grammar issues, such as the sentence of the XRD section in the third paragraph beginning with "Despite this instability produces...." but I suppose these are minor issues.

McBride, Raymond rmcbrid5@ur.rochester.edu Mon, Apr 25, 2022 at 11:43 PM
To: Ranga Dias <rangadiaz@gmail.com>, "nathandasenbrockgammon@gmail.com"<nathandasenbrockgammon@gmail.com>, "Durkee, Dylan" <ddurkee@ur.rochester.edu>, "Snider, Elliot"<esnider3@ur.rochester.edu>, "Wadhurawa Mudiy, Hiranya" <hwadhura@ur.rochester.edu>

I like the paper, the figures look good and its well written. However, I am a little concerned about the way that the paper implies that all measurements were taken on samples that we synthesized. While we have synthesized this material none of the measurements of conductivity, susceptibility, or heat capacity were taken on synthesized samples. This isn't as important but I noticed that in table 1 it says that the sample is malleable, do we have any evidence to support this? I thought that the sample seemed brittle, but I could be wrong its hard to tell with such small samples.

b. Post-Publication Co-Author Communication.

Nathan D.G. nathandasenbrockgammon@gmail.com Sun, Jul 9, 2023 at 6:39 PM
To: Ranga Dias <rangadiaz@gmail.com>
Cc: Elliot Snider <elliotmsnider@gmail.com>, "Wadhurawa Mudiy, Hiranya" <hwadhura@ur.rochester.edu>, NugzariKhalvashi-Sutter <nkhalvas@u.rochester.edu>, Sasanka Munasinghe <sasankauditha@gmail.com>,

"McBride, Raymond"<rmcbrid5@ur.rochester.edu>, "Dissanayake, Sachith" <sachith.dissanayake@rochester.edu>

Hello all,

Upon reviewing the comments and questions brought up by Hamlin through Nature I believe we should respond to them. It is a bit ridiculous these issues are being brought up post-review, but having gone through the comments none of them should be particularly difficult to respond to. To that end, here is an outline of how I think best to respond to their three points:

1. Their first point is asking about background subtraction and which data had a background subtracted. This should be straightforward to respond to and say which data had a background subtracted and a justification for why. I do not understand the comment about "In the instrument you have an option to pick the offset voltage automatically." To my knowledge this was not done, and raw data was recorded from the lock in / current source and backgrounds subtracted in origin. However, this is a straightforward question to respond to with simply stating which data was background subtracted and why.

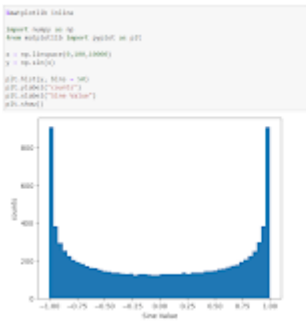
2. Their second point is the apparent "unusual feature" in noise from the resistance data, and asking to "clarify how the data came to have such structure." The answer to this is that there is no a priori reason why the data ought to or ought not to have such structure, and such a comment is just throwing unwarranted suspicions our way.

However, looking at the situation for a few minutes and running a very quick simulation I was able to near perfectly reproduce the alleged "unusual feature" (see attached image for figure and code) and provide some clear physical arguments for why such structure is not only not unusual, it is in fact the expected behavior for such a measurement – there's actually some pretty interesting data science going on here. While the comment assumes that the noise ought to be Gaussian, for the situation of measuring the voltage from a lock in amplifier this is simply not the case. The noise during these measurements is inherently periodic, and this is clearly seen by looking at the Voltage vs Time plot on the front of the lock in itself. The voltage "wanders" with a very clear periodic pattern, moving up and down in a sinusoidal way with time. Our measurements are done by recording the voltage at a certain time interval. In this way we are essentially randomly sampling from a sine curve, and taking a uniform random sampling from a sine curve produces the histogram I have attached. Here is someone on a stack exchange talking about a similar issue, while also introducing a small amount of random noise that would better represent our physical situation:
https://stats.stackexchange.com/questions/126273/probability-distribution-for-a-noisy-sine-wave

3. They question the Rc = R0 + aT^2 + bT^5 and how that background produces the data presented in the figure. This one is very easy to respond to by simply providing the R0, a, and bused for the background and showing that when applied it does in fact yield the data presented in the figure from the raw data.

I think by responding to these three questions directly and strongly, we give ourselves a platform to stand on should Nature decide to draw things out further at which point a reevaluation might be necessary.

That said, I am not in a position where I am able to dedicate any more time or effort to this than I already have, and will defer to the rest of you for how to respond.



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25K

The involvement of co-authors in the lifecycle of a scientific paper, from conception through to post-publication critique, is instrumental and multifaceted. This is vividly illustrated in the context of the University of Rochester's investigation into the LuHN paper. Prior to publication, the co-authors were deeply engaged in refining the manuscript, a process that not only enhanced the scientific merit of their work but also solidified their collective responsibility towards maintaining the integrity and quality of the publication. Their active participation in this phase starkly contrasts with the Investigation Committee's portrayal of them as mere "victims," a narrative that fails to recognize their significant contributions and proactive involvement in the scientific process.

The co-authors' responses to pre-publication feedback, ranging from addressing typographical errors to engaging in substantive scientific and methodological discussions, underscore their commitment to scientific excellence and ethical conduct. This collaborative diligence is foundational to fostering a transparent and ethical scientific community. Furthermore, their unified stance and evidence-based strategy in addressing post-publication critiques, particularly those raised by James Hamlin, exemplify the critical role of co-authors in defending and supporting their work's integrity and credibility. The detailed and methodical rebuttal led by Nathan D.G. not only addressed the critiques directly but also added further clarity and depth to their original findings, showcasing the strength of collaborative effort in upholding scientific standards. This response strategy was not merely defensive but was constructed to clarify and illuminate the scientific discourse, thereby contributing to the broader scientific community's understanding of their findings.

Firstly, the co-authors' readiness to address concerns about background subtraction and data features directly—pointing out the standard practices and justifications for their methodologies—highlights their commitment to transparency and scientific integrity. Nathan's detailed explanation regarding the "unusual feature" in the noise from resistance data, supplemented by a simulation, not only refuted the critique but also added value to the original findings by clarifying the expected behavior of such measurements. This depth of response signifies the co-authors' thorough engagement with their work and their readiness to defend its validity with additional analysis.

Furthermore, the ease with which the co-authors planned to address Hamlin's critique, as articulated by Nathan, underscores their confidence in the robustness of their research methods and results. The critique, rather than being a setback, provided an opportunity for the co-authors to further elucidate aspects of their research, thereby enhancing the scientific community's understanding of their work. This readiness and ability to engage constructively with critiques reflect a proactive approach to scientific discourse, where challenges are seen as opportunities for clarification and growth.

The co-authors' collective response to Hamlin's critique also highlights the importance of collaboration and shared responsibility in the post-publication phase of research. By pooling their knowledge and expertise, the co-authors were able to formulate a comprehensive and coherent response, demonstrating the strength of collaborative effort in upholding the quality and integrity of scientific publications.

The characterization of the co-authors as "victims" by the Investigation Committee, considering their substantive involvement and collaborative role in the research and publication process, appears disingenuous. This portrayal overlooks the active and engaged participation of each co-author in the development, refinement, and defense of the LuHN paper. Through their extensive email communications, the co-authors demonstrated not only their deep involvement in addressing the scientific nuances of the paper but also their collective effort to respond to critiques and uphold the integrity of their work post-publication. Referring to them as "victims" undermines their agency and responsibility as integral contributors to the scientific discourse surrounding their publication. Such a label seems to misrepresent the proactive and collaborative spirit with which the co-authors approached both the development of their research and their response to subsequent critiques. It is essential that the Investigation Committee's assessments accurately reflect the active role and accountability of all co-authors, acknowledging their contributions and responsibilities in the scientific process rather than diminishing their involvement through mischaracterization.

2. Evaluating the Consistency of Investigative Standards: The LuHN Data Controversy.

As the PhD supervisor for Nathan Dasenbrock-Gammon and Elliot Snider, who are both co-authors of the LuHN paper, "Evidence of Near Ambient Superconductivity in a N-doped Lutetium Hydride," published in March 2023 in Nature, I have been deeply immersed in the investigation process led by the University of Rochester. My involvement has provided me with a unique perspective on the unfolding situation, particularly concerning the interpretation of the LuHN data by the Investigation Committee.

The core issue that has emerged through this process is the seeming contradiction in how the LuHN data is perceived by the Investigation Committee versus its acceptance by the University in supporting the PhD dissertations of Nathan Dasenbrock-Gammon and Elliot Snider. Despite the Committee's efforts, facilitated by Stephen Dewhurst, the University liaison, and Leslie Thornton, the University attorney, to draft a letter to Nature calling for the paper's retraction, it's important to note that Dasenbrock-Gammon and Snider fully supported the validity of the LuHN data as presented in their respective dissertations. However, they signed a letter as co-authors of the LuHN paper, essentially admitting that their data was fabricated and/or falsified. This fact adds a layer

of complexity to the situation, highlighting a significant inconsistency in the evaluation of the same data set when used for different purposes.

This inconsistency raises profound concerns about the objectivity and fairness of the investigative process. On one hand, the Committee seems to be pushing for a narrative that suggests research misconduct based on the LuHN data. On the other hand, the University has deemed this same data as acceptable for the highest academic accolade – the awarding of PhDs to Dasenbrock-Gammon and Snider. This discrepancy is not only perplexing but also indicative of a potential misinterpretation or selective scrutiny of the data by the Investigation Committee.

Upon bringing these concerns to the attention of Prof. Dewhurst and the University on October 13, 2023, I hoped to highlight the need for a reassessment of the Committee's conclusions, especially considering the co-authors' endorsement of the data's integrity within their academic work. The University's lack of action in addressing these discrepancies not only undermines the credibility of the investigative process but also suggests an adherence to a predetermined outcome that overlooks the nuanced and complex nature of scientific inquiry.

The situation underscores a troubling inconsistency in the evaluation of the LuHN data, which has been validated for the purpose of academic recognition yet questioned for its integrity in publication. This selective skepticism towards the data, especially in light of the co-authors' full support of its validity, calls into question the standards and objectivity employed by the Investigation Committee. It highlights the critical need for a more consistent and equitable approach to evidence evaluation, ensuring that the investigative process remains unbiased and true to the principles of academic and scientific integrity.

In light of these considerations, the differential treatment of the LuHN data—affirmed for academic achievements but contested in the public domain—necessitates a thorough reevaluation of the investigative findings. Such a reevaluation is essential to uphold the integrity of the scientific process and to ensure that conclusions are drawn based on a comprehensive and impartial assessment of all available evidence.

3. Providing a Co-Author with a Contract and Financial Remuneration based on the LuHN Data.

Around August 10, 2023, Dr. Sachith Dissanayake, who was a Research Assistant Professor in my research group in the Department of Mechanical Engineering at the University of Rochester, decided to terminate the contractual agreement we had. This contract, which started on July 14, 2023, and was set to conclude on July 13, 2025, was funded through grant financing.

I later learned that Dr. Dissanayake's decision to end our contract seemed influenced by the University of Rochester offering him a separate contract, including direct remuneration from the University itself. Following this development, I became aware of Dr. Dissanayake's involvement in activities that seemed to counteract my ongoing work. Given these events, it appears plausible that his actions were swayed by the terms of his new contract with the University of Rochester, which involves direct financial compensation.

The timing of Dr. Dissanayake's new contract with the University of Rochester and his subsequent termination of our contract raises concerns over potential impropriety. This situation, where he ended our agreement shortly after receiving an alternative offer from the University, could be perceived as a conflict of interest or indicative of bias. The alignment of this significant change in Dr. Dissanayake's employment with efforts that seem to undermine my work naturally leads to questions about the integrity of the academic and professional relationships involved. Clarity and openness in these matters are vital to uphold trust and credibility in academic settings and research activities.

It is important to note that after Leslie Thornton finalized the letter intended for Nature, Dr. Dissanayake independently approached one of my students, Sasanka Munasinghe, to sign the letter, giving him only one day to decide. This action clearly indicates that the decision was made without comprehensive discussion among all involved parties.

In his interaction with Sasanka Munasinghe, Dr. Dissanayake stated that the letter had been prepared by the University of Rochester's legal counsel, suggesting it was appropriate for him to sign. In this scenario, Dr. Dissanayake used the University's legal counsel and Stephen Dewhurst as leverage to influence and pressure Sasanka Munasinghe to sign. This example is indicative of a broader pattern, leading to the concern that similar tactics might have been used with other individuals involved in the situation.

4. Deception to Justify Interference with Co-Authors.

To justify the University's and the Investigation Committee's interference with the co-authors in spearheading a request for the LuHN paper's retraction while the investigation was ongoing, they relied on a statement from the co-authors, expressing regret for not raising concerns contemporaneously due to perceived dependencies on me. However, a closer examination reveals the factual inaccuracy of this assertion.

Firstly, it is evident that the statement cannot hold true in light of the timeline. Co-author Nathan Dasenbrock-Gammon had ceased his affiliation with my lab in October 2022, several months before the paper's publication in March 2023. During this period, he was no longer under my supervision nor financially linked to the lab, thus having the freedom to communicate concerns to the publisher independently. Yet, no such communication occurred until the university and the Investigation Committee orchestrated the drafting of the retraction request letter, coercing co-authors to sign it.

Similarly, co-author Dylan Durkee had severed ties with my group in July 2022, almost eight months prior to the paper's publication. During this extended period, he too had ample opportunity to communicate any reservations directly to the publisher. Again, there was no such communication until prompted by the university and the Investigation Committee.

Furthermore, co-author Hiranya Pasan, who was not financially dependent on my lab but rather funded by the LLE as a Horton Fellow, also had the liberty to express concerns independently. Yet, like the other co-authors, he only voiced objections upon the university and the Investigation Committee's intervention.

All co-authors were afforded the freedom to express their ideas and concerns throughout the study. I ensured an environment where dissenting opinions were welcomed and considered. The points raised in the retraction request letter were thoroughly discussed with all co-authors, who were given the option to withdraw from the study if they had reservations. Their subsequent agreement and commitment to publication, as evidenced by pre- and post-publication email communications, demonstrate their awareness and consent.

The assertion by the Investigation Committee that co-authors "did not feel that we were able to speak freely" is unequivocally false and indicative of a predetermined agenda. This reliance on fabricated statements underscores the University's manipulation of the Investigation Committee to serve its desired outcome, rather than pursue truth and integrity in the investigation process. Such an approach is wholly inappropriate and undermines the credibility of the investigation.

5. Conclusion.

In the final analysis of the situation concerning the investigation into the LuHN paper by the University of Rochester, it becomes clear that there exists a significant divergence between the actions and conclusions of the Investigation Committee and the evidential reality as presented by the contributions and communications of the co-authors. The Investigation Committee's portrayal of the co-authors as mere "victims" starkly contradicts the substantial evidence of their active, knowledgeable involvement in the research and publication processes. This mischaracterization not only undermines the co-authors' accountability but also obscures the pre-determined outcome driven approach adopted by the University.

The extensive email correspondences and detailed contributions of the co-authors prior to and following the publication of the LuHN paper unequivocally demonstrate their significant engagement and responsibility in both the crafting and defense of the paper's findings. Their proactive responses to criticisms and suggestions for revisions prior to publication, along with their robust defense against post-publication critiques, highlight a deep commitment to scientific integrity and the advancement of knowledge. This is contrary to the Investigation Committee's implication that the co-authors were passively implicated in the purported research misconduct.

The decision by the Investigation Committee to question the validity of the LuHN data, while simultaneously accepting this data to support the PhD dissertations of Nathan Dasenbrock-Gammon and Elliot Snider, underscores a troubling inconsistency that merits closer scrutiny. This discrepancy, particularly when viewed considering the co-authors' full support for the data's integrity, suggests a potential misinterpretation of the evidence to support pre-determined conclusions of research misconduct.

Moreover, the situation involving Dr. Sachith Dissanayake's termination of our contract, after accepting a direct offer from the University of Rochester, further complicates the narrative. This sequence of events, coupled with actions that seem to undermine my work, points towards a concerning pattern of behavior that could be interpreted as biased or influenced by external motivations. The approach taken by Dr. Dissanayake in soliciting signatures for the retraction letter, leveraging the University's legal counsel and administrative figures, adds another layer of

complexity, indicating a possible use of institutional influence to shape the outcome of the investigation.

These developments collectively highlight the necessity for a transparent, fair, and unbiased review process. The integrity of academic research and the credibility of the investigative framework rely on the consistent application of standards and the impartial assessment of all evidence. As we move forward, it is imperative that the academic community and its governing bodies reflect on these events to ensure that the principles of fairness, objectivity, and scholarly integrity are upheld in all aspects of academic inquiry and resolution of disputes.

XI. Overall Conclusion

In concluding this Supplemental Report, it is imperative to reassert the foundational integrity and scientific validity of our work amidst the criticisms and accusations. The Investigation Committee's findings, while undoubtedly arising from a place of due diligence, reflect a series of misunderstandings and misapplications of scientific standards and methodologies pertinent to high-pressure superconductivity research.

First and foremost, the assertions regarding the fabrication and falsification of data, notably the $\chi(T)$, R(T), and Tc(P) measurements, are unequivocally refuted. Our methodologies, particularly the use of A.C. susceptibility, were misconstrued as evidence of the Meissner effect, a misunderstanding that underscores a broader misinterpretation of our research objectives and outcomes. It is crucial to highlight that in the realm of high-pressure superconductivity, the customs and practices, including the publication of unprocessed data, diverge significantly from those in other scientific fields. This nuanced context seems to have been overlooked by the Committee.

Furthermore, the unanimous consensus among nine esteemed scientists, affirming the absence of data fabrication or manipulation, stands as a testament to the credibility of our research. This significant endorsement, regrettably dismissed by the Committee, reinforces the integrity of our findings. The Committee's reliance on flawed analyses and scientifically unsound methodologies further detracts from the credibility of their conclusions, undermining the constructive discourse necessary for scientific advancement.

Our data, criticized by the Investigation Committee, has been validated through replication efforts, further supporting our contributions to understanding hydride superconductivity. The allegations of data falsification, particularly concerning the 138 GPa inset and the misinterpretation of our experimental results, are unfounded. The comprehensive raw data, accessible to the Investigation Committee, alongside the maintenance of data integrity by multiple researchers, corroborates the authenticity and reliability of our findings.

Addressing the critique of plagiarism, it is essential to recognize the inherent limitations in the expression of common scientific methods and background information. The alleged plagiarism, pertaining to a single sentence in our response to criticism, does not equate to intentional misconduct but highlights the challenges in scientific writing.

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In reflection, my collaboration with Prof. Ashkan Salamat, while deemed a mistake in hindsight, was not borne of malicious intent but rather an earnest pursuit of scientific inquiry. The misapplication of "typical behavior" to our experimental results by the Investigation Committee reveals a fundamental misunderstanding of the complexities inherent in high-pressure, low-temperature superconductivity experiments.

The investigation into the LuHN paper by the University of Rochester, as analyzed, reveals a profound disconnect between the Investigation Committee's conclusions and the actual contributions of the co-authors, challenging the portrayal of these co-authors as mere "victims" and highlighting their active involvement in the research and publication process. The evidence, particularly through extensive email correspondence, shows their significant role and commitment to scientific integrity, contradicting the Committee's suggestion of passive misconduct involvement. Additionally, the University's contradictory acceptance of the same data for PhD dissertations while questioning its validity in the investigation indicates an inconsistency that undermines the process's integrity. Furthermore, Dr. Sachith Dissanayake's contract termination and the implications of bias and conflict of interest add complexity to the narrative, suggesting that the investigation may have been influenced by factors beyond straightforward data evaluation.

As we move forward, it is my fervent hope that this Supplemental Report clarifies the misconceptions and inaccuracies presented by the Investigation Committee. Our commitment to scientific integrity and the pursuit of knowledge remains unwavering. I invite further scrutiny, dialogue, and collaboration, believing firmly that through open and constructive engagement, we can advance our collective understanding of superconductivity. The path to scientific discovery is fraught with challenges, yet it is through these adversities that we refine our methodologies, strengthen our convictions, and contribute to the vast tapestry of human knowledge. Let us proceed with a shared dedication to truth, integrity, and the relentless pursuit of scientific excellence.

* * *

To the extent that the University of Rochester is prepared to seriously address the issues that I have identified in my comprehensive response and this supplemental response, I wish to express my sincere willingness to appropriately engage collaboratively with the University of Rochester in addressing and rectifying the various misunderstandings evident in its draft report and likely its final report, a copy of which has not been provided to me. My comprehensive responses have highlighted several key areas where scientific and experimental interpretations, particularly pertaining to the low temperature, high-pressure superconductivity research, may benefit from further clarification and correction. I am committed to providing detailed insights and expertise to assist the University of Rochester in accurately understanding the complexities of this research. My aim is to ensure that there is a thorough understanding of the scientific principles and experimental nuances involved. I look forward to appropriate constructive and fruitful dialogue with the University of Rochester to achieve a comprehensive and accurate representation of the research in question.

/s/ Liyanagamage R. Dias	February 21, 2024
Liyanagamage R. Dias, PhD	Date